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# CORRIGENDA

*Journal*, Part III 1942 p. 213 ( Estimation of Many Parameters  
by R. C. Geary)

Formula (1) *should read*

$$n = \prod_{i=1}^k p_i^{n_{xi}} / (n_{1i})$$

Inequality (15) *should read*

$$\left| \sum_{a=1}^k m_a m_a p_a \right| \left| \sum_{a=1}^k m_a p_a^j \right|^2 \leq \left| \sum_{a=1}^k \frac{p_a p_a^j}{p_a} \right|$$

In formula (13) *n should read n'*



# JOURNAL OF THE ROYAL STATISTICAL SOCIETY PART I, 1943.

THE MORTALITY OF ADULT MALES SINCE THE MIDDLE OF THE EIGHTEENTH CENTURY AS SHOWN BY THE EXPERIENCE OF LIFE ASSURANCE COMPANIES

By SIR WILLIAM P. ELDERTON, F.I.A., and M. E. OGBORN, F.I.A.

[Read before THE ROYAL STATISTICAL SOCIETY, March 16th, 1943, PROFESSOR M. GREENWOOD, F.R.S., in the Chair.]

## *Introduction*

THE object of this paper is to give some idea of the changes in rates of mortality in this country among male adults so far as they can be judged over a long period from statistics collected from insurance companies and to compare the results with those obtained for the general population.

The Mortality experienced by British life assurance companies has been studied on various occasions, and investigations have been made of the combined experience of a number of offices. In addition to these combined efforts individual companies have worked out their own experience either, in the early days, because no standard tables were available for use, or because a particular company wished to see how far its own experience differed from the standard tables.

Life assurance, as we now know it, began in 1762, when the Society for Equitable Assurances on Lives and Survivorships was founded. Before that date the Charter Companies (the London Assurance and the Royal Exchange Assurance) had issued life assurance policies for short terms on persons under the age of 45 nearly always for a year or less, at premiums that did not depend on the age. There was also a small amount of insurance of a kind, granted by the Amicable Society, on a sharing-out basis, but it was not life assurance as we now know it. From 1762 till early in the nineteenth century the only company doing any appreciable amount of permanent life assurance business was the Equitable, and records of its mortality were kept by William Morgan and disclosed from time to time by him. The method adopted by him, at the suggestion in the first instance of his uncle Richard Price, was to compare the actual number of deaths with those that "should have died" according to the tables on which the premiums were based, and this meant in effect that he compared the actual deaths with those expected by the Northampton Table as Dodson's earlier table was discarded and the premiums revised in 1781. These records give an idea of the way the mortality of assured lives changed between 1762 and 1832, when, so far as can be traced, they were discontinued. On the basis of Morgan's statements, attempts were made to form a mortality table, and Griffith Davies produced a table in 1825.<sup>1</sup> \* William Morgan and his son Arthur, who succeeded him as Actuary of the Equitable, appreciated that as Griffith Davies had incomplete information, his table gave only a rough idea of the

\* The numbers refer to the list of books and papers appended hereto.



mortality, and in 1834 Arthur Morgan<sup>2</sup> produced tables which gave the mortality experience of the Equitable from September 1762 to 1829—these were the first tables that showed insurance mortality satisfactorily and gave the mortality not only according to attained age, but also according to the time since an assurance was granted. It had been appreciated in a general way before this work appeared that, as unhealthy people were not accepted for assurance, the mortality at any age would be less for those who had been assured recently than for those who had been assured for some years, but no attempt had previously been made to give any measure of this "selection."

Except for the years 1829–32, for which Arthur Morgan gave an abridged record, no further information is now available of the experience of the Equitable for over thirty years, but when the Institute of Actuaries and the Faculty of Actuaries in Scotland made an investigation into the mortality of lives assured by nearly all the companies from 1863 to 1893, cards were prepared by each contributing company, and H. W. Manly<sup>3</sup> made an investigation of the experience of the Equitable, and published some of the results in the *Transactions of the VIIIth International Congress of Actuaries*.

From 1893 there is again a long gap, but from 1924, when the Continuous Mortality Investigation of the Institute and the Faculty of Actuaries was started, information is available for the Equitable in a form which lends itself to comparison with the earlier investigations.

During the two gaps the Company made comparisons for office use of actual with expected mortality, but such little information as is still available is insufficient to provide rates of mortality, and we have therefore to rely on the three experiences, the first for 1762–1829 with an average date of about 1810, the second for 1863–93 with an average date of 1878, and the third for 1924–38 with an average date of 1931.

Before discussing these experiences it is advisable to give some information about the Company and its assured.<sup>4</sup> The Company has always been a mutual assurance company which has never paid commission nor employed agents. In the early years a substantial proportion of the business was for short terms of less than five years, and generally for one year only. This was the natural result of the type of insurance granted by the Charter companies with which, alone, people were then familiar. Such assurances were usually needed to cover money-lending transactions, and the same remark applies to nearly all the few survivorship assurances and to a part, but relatively small part, of the ordinary whole life assurances. There is little doubt that insurances taken out for money-lending purposes show a heavier mortality than those taken out for provident reasons. Table I gives the number of assurances in various years. From about 1785 the provident type of business steadily increased in proportion, and bearing in mind that term business can only remain in force for a short time, it may be assumed that even the earliest experience (Arthur Morgan's) expresses, with but little exaggeration, the mortality of a provident type of assured lives drawn mainly from the professional and business classes with a definite sprinkling, on the one hand, of landed gentry and, on the other, of clerks and servants who came to the Society often because their employers were assured or in some other way were connected with the Society. The average sum assured was £1,000 per policy after the Society was firmly established. The general trend of the new business can be seen from Table I; it may be mentioned that the number of new assurances remained roughly constant from 1784 to 1816, except in the

years 1789-92 and the year 1810, when exceptionally large numbers were effected. The new business then dropped, owing to an intentional restriction<sup>2</sup> of business, with the result that new business was trifling in amount during the period (1863-93) covered by Manly's experience. The new business increased slowly from 1870, and substantially after 1919.

TABLE I

Years					Average number of assurances issued in a year
1770-9	...	...	...	...	245
1780-9	...	...	...	...	587
1790-9	...	...	...	...	807
1800-9	...	...	...	...	679
1810-9	...	...	...	...	683
1820-9	...	...	...	...	313
1830-9	...	...	...	...	197
1840-9	...	...	...	...	185
1850-9	...	...	...	...	118
1860-9	...	...	...	...	108
1870-9	...	...	...	...	172
1880-9	...	...	...	...	133
1890-9	...	...	...	...	310
1900-9	...	...	...	...	265
1910-9	...	...	...	...	282
1920-9	...	...	...	...	647
1930-8	...	...	...	...	1,327

*Notes.*—The total number of assurances in force in 1767 was 168.

From 1890 onwards the numbers include classes of assurance that are not brought into the mortality investigation, such as double endowments, deferred assurances, etc.

For about the first hundred years the lives assured were not examined by a medical man, though evidence of health was obtained before assurances were granted, but from 1858 till 1914 a medical examination was considered to be essential. Since 1914, however, an increasing proportion (running up to 40 per cent. in 1938) of the new business has been accepted without medical examination.

We can now turn to the three experiences, and after discussing them, some comparisons can be made with the published combined mortality of assured lives and with the mortality of the general population.

#### 1762-1829

In describing this experience, Arthur Morgan<sup>2</sup> says that it exhibits "in one view the duration (so far as the same can be traced) of *all* the lives which have been assured in the Equitable Society from the time of its commencement in September 1762 to the 1st of January 1829," but in a footnote he adds "185 new members were admitted into the Society, in the course of the whole year 1829 at various ages: these are not included . . . although the mortality of that year is included. . . . The reason for this omission will be apparent from a consideration of the principle upon which tables of this kind are formed, and of the information they are intended to convey, namely, the number of deaths which have happened or may be expected to happen, out of a certain number

of individuals at any given age before they shall attain the next year of age; in other words, how many persons out of a given number existing at any age will survive to the next succeeding year of age. In conformity with this principle, the duration of the lives of those who are, or have been Members of the Society, is reckoned according to the number of entire years of age which they have completed since the time of their admission.

"A person, therefore, making assurance in the course of the year 1829, in the 31st year of his age, cannot be reckoned as having lived a year in the Society on the 31st December 1829; and is not to be added until 1830, when he must be classed under the age of 31, as he would complete his 32nd year in 1830, and have entered his 33rd year on the 1st January 1831, should his life have so long endured."

Morgan's "Table A" [see <sup>2</sup>] gives a series of columns as shown in Table II, where age 18 is taken as an example.

TABLE II

Age on admission	Age 18			
	Attained the above age	Living January 1, 1829, at the above age	Discontinued their assurances	Died
7	18	—	—	—
8	31	—	1	—
9	14	—	1	—
10	19	—	2	—
11	26	—	1	—
12	27	—	1	—
13	38	1	1	1
14	38	—	2	—
15	39	—	3	1
16	62	1	7	1
17	69	1	5	—
18	149	—	—	—
	530	3	24	3

It is, we think, clear from these tables and from the Introduction, where Morgan gives a comparative statement of the rates of mortality,\* that to obtain the rate of mortality at age 18 he would have used  $3 - (530 - \frac{1}{2} \text{ of } 24)$  0.006. Similarly  $1 - (62 - \frac{1}{2} \text{ of } 7)$  would give the rate of mortality between exact age 18 and exact age 19 of those who were admitted at age 16.

So far as the mere calculation of rates of mortality is concerned, this seems simple, but there has always been some doubt as to exactly how Morgan compiled his statistics and how they should be interpreted. Manly,<sup>3</sup> for instance, came to the conclusion that Morgan had assumed that lives accepted for assurance at age 31, say, next birthday in any calendar year attained exact age 31 at the end of the year, that discontinuances were evenly distributed both throughout each year of age and each calendar year, and that the experience ended in effect

Morgan does not give any rates of mortality at individual ages: the rates of mortality he gives are for groups of 5 or 10 years of age and are stated, for instance, for ages 30 to 35 as one death in 130 for all ages of entry and as one in 142 for persons assured at age 30.

on January 1st, 1829, at which date the then existing lives were counted. This was in effect the "calendar year" method used in constructing the Seventeen Offices' Experience<sup>6</sup> and the  $H^M$  and  $H^{(5)}$  tables from the Institute of Actuaries Twenty Offices' Experience.<sup>7</sup> Manly also thought that Morgan had ignored the period from entry to the end of the calendar year of entry.

We do not think that Manly's interpretation is correct. Morgan specifically says that he used "*all the lives assured*," and we have been able to confirm from a MS. book of tables of deaths that many deaths were included when the assurances were only a few months in force. His own description in the passage quoted above implies that he worked from exact age  $x$  to exact age  $x + 1$ , and so far as the deaths are concerned, his MS. book appears to confirm this. Though the final sentence quoted above from Morgan's account obscures his procedure, we have come to the conclusion that rates of mortality calculated in the way we have indicated give what Morgan did and, apart from the first year, represent with reasonable accuracy the rates of mortality age by age. As to the first year of assurance, we take the view that he dealt with the part of the year of age up to the attainment of the exact age, and consequently what appears as the first year only related to an average period of half a year. If it related to a whole year, the mortality in the first year of assurance is less than half that of the second year, and while we might expect some difference in favour of the first year, it is unlikely that, without medical examination, the mortality of assured lives would, in the period to which the experience relates, have been little more than 40 per cent. of that in the second year. We must admit, however, that in calculating his rates of mortality, which he did for groups of five ages, Morgan treated the first year exactly as if it was a complete year, and we think this vitiates to some extent his comparison between the rates of mortality for a specific age of entry with the aggregate rates of mortality regardless of age of entry. In mitigation of this error it may be pointed out that a lot has been learnt about the calculation of rates of mortality since 1830, and that as Morgan only gave his rates of mortality in groups of 5 years of age, he hid the error from himself; for what he was doing, if our interpretation is correct, was to compare an average of  $4\frac{1}{2}$  years of mortality with an average of 5 years, and while no doubt a 50 per cent. error in the first year is easy to notice, a 10 per cent. error is not so obvious, especially when it is obscured by the inevitable variations when small numbers are involved.

The actuaries responsible for the Seventeen Offices' Experience made use of Morgan's work, and they calculated rates of mortality for groups of ages at entry during the remainder of life. They assumed that for the first year of assurance they had a full year's deaths, but they, too, by the way they grouped the ages at entry, made it difficult to detect the very low rate of mortality that they were assuming for the first year of assurance.

It is also possible that Morgan may have mis-stated the exposed to risk or deaths for the last year of the experience. We have verified his statement that he included deaths that occurred in 1829, and if he included only those deaths that occurred before the birthday of the life assured in 1829 and included discontinuances on the same principle, and counted as alive at the end of the experience those who reached their birthdays in 1829, then all was well. If, however, Morgan had not a full year's exposure in his statistics for the final year, the rates of mortality are understated, but we cannot make the adjustment, if one is required, from the information available. We are satisfied that at the worst it could hardly be perceptible in the rates of mortality.

"Lives," not "policies," were used, so that if a number of policies was taken out on a man's life he would have been counted in the experience once only, and presumably for the maximum period for which he was assured under the various assurances.

There were a few female lives assured, but so few that the experience can be regarded as giving the mortality of male lives assured. In a few cases extra premiums had been charged for travel or for some illness—e.g., gout—but, generally speaking, the assurances had been acceptable at the ordinary rates of premium.

From Morgan's statistics the figures in Table III \* were obtained. They give the rates of mortality (i) for the full aggregate of all lives regardless of age at entry, (ii) for the first year of assurance in Morgan's sense, which, as already explained, relates, in our view, to a half-year, (iii) for the next four years of assurance, (iv) for all lives, but excluding any experience during the first five years of assurance in Morgan's sense, but, in our view, excluding about the first four and a half years of assurance. We have given the rates of mortality in groups of five years of age except at the youngest and oldest ages, where wider groupings are adopted; the material is insufficient to justify the finer grouping.

Table VI gives the "exposed to risk" and deaths, so that the weight to be attached to any rate of mortality in Table III can be assessed roughly. The standard error in the number of deaths could be taken approximately as the square root of the number of deaths if there were only one assurance on each life, but would be greater if there were duplicates.<sup>8</sup>

It will be noticed from Table III that the aggregate rates of mortality are slightly less than the rates of mortality when the first four and a half years of assurance are excluded, so that the selection of lives had a definite effect, though, judging by the rates of mortality in the intermediate columns, only for about two years from the date of assurance.

#### 1863-1893

Manly's investigation<sup>3</sup> was based on whole life and joint life with profit assurances, which constituted almost all the business. He used nearest age at entry (approximately exact age at entry), nearest duration for withdrawals and curtate duration for deaths. The assurances were traced from the anniversary in 1863 of the date of entry, or from the date of entry of assurances effected between 1863 and 1893, until death or withdrawal, or until the anniversaries in 1893. The method is a policy year method, and was that used in the Combined Experience of the Institute and Faculty<sup>9</sup> for the same period from which the groups of tables known as the  $O^M$ ,  $O^{SM}$ , etc., were constructed. Manly included duplicates, except that if two or more assurances were taken out simultaneously, one only was counted, and if they continued for different periods, the one that continued longest was alone counted. The experience related to male lives, and excluded assurances on which an extra premium had been charged.

Tables IV and VII give information similar to Tables III and VI. Owing to the small amount of new business, the rates of mortality in the first five years of assurance are somewhat hard to follow, and have little effect on the aggregate rates of mortality. In this connection it is of interest to mention that Manly, in his paper to which reference has already been made, gave it as his opinion

\* Tables III to XIII are appended to the paper.

that selection could be traced as continuing for 15, or even 20 years. His argument was that though it was difficult to draw conclusions from the statistics of individual years of assurance, owing to the small numbers, the rates of mortality calculated according to the years of assurance do not rise to the aggregate rates of mortality excluding those years of assurance, and that, until they reach an ultimate aggregate mortality, selection is still in operation. This view of selection was generally held, and it was then thought the explanation lay in the initial medical selection of the lives assured. There are, however, other possible explanations,<sup>10</sup> such as, for instance, (a) that the withdrawals by lapse or surrender occur among the healthy rather than the unhealthy, for a dying man is unlikely to give up life assurance, or (b) that the initial selection has been improving with time and was better at the end of the experience than at the beginning.

#### 1924-1938

This experience is based on whole life and endowment assurances on males,\* including both with profit and non-participating assurances, and whether the lives were medically examined or not, provided the normal terms had been charged. In the previous experiences there were no non-participating assurances and no endowment assurances, as the Equitable did not grant such assurances before 1893, although they were freely granted by other insurance companies. The proportion of cases accepted on special terms was far greater in the period 1924-38 than in the earlier experiences; in the earlier periods assurances were more generally either accepted at ordinary rates or declined, whereas recently declinations are few, as in nearly every case not acceptable at ordinary rates special terms were offered. The 1924-38 experience excludes certain special classes of assurance, for instance, double endowments (*i.e.*, £2,000 on surviving  $n$  years and £1,000 on death within the  $n$  years), because such assurances can be and have been granted on under-average lives. The experience also excludes children's deferred assurances even after the actual assurance has come into force, and certain substantial numbers of cases accepted in block without any evidence of health—these had no counterpart in the earlier experience.†

About three-quarters of the life assurance business is included, and it is, so far as can be told, that part of the business which corresponds, as regards the type of life, with the earlier experiences. There were many people having a number of policies on their lives; this prevailed to a much greater extent than in the earlier experience, and duplicates were not eliminated.

The method adopted for tabulating the experience was to record the number of assurances at each duration at the beginning of each calendar year at nearest (approximately exact) age. Deaths were recorded for each calendar year according to the duration and nearest age at death. The exposed to risk,  $E$ , shown in Table VIII was then taken as  $\frac{1}{2}(P_{x(n,r)} + P_{x(n,r+1)}) + \frac{1}{2}\theta_{x(n,r)}$ , where  $P_{x(n,r)}$  is the population at the beginning of the calendar year  $r$  at nearest age  $x$  for a given curtate duration  $n$ ,  $P_{x(n,r+1)}$  is the population at the beginning of the year  $r+1$  (*i.e.*, the end of the year  $r$ ) at the same age and duration, and  $\theta_{x(n,r)}$  the

\* Female lives were excluded as far as possible, but small numbers of female lives may have been included.

† To a small but possibly appreciable extent slightly under-average lives have been accepted at ordinary rates for with profit endowment assurances, where, owing to the nature of the impairment, it seemed justifiable because the bonus system is such that a substantial part of the bonuses is not payable at death, but only on survival to the end of the term of the assurance.

deaths that occurred in the calendar year  $r$  at the same nearest age and at the curtate duration  $n$  at the time of death. The rate of mortality at age  $x - \frac{1}{2}$  for assurances of duration  $n$  is therefore given by  $\theta/E$ .<sup>\*</sup> This method is similar to that used in Census work, and though it is unlikely to give exactly the theoretically accurate results of the policy year method used in the 1863–93 investigation, it should give good approximations to the rates of mortality.

The statistics were only conveniently available in the age groups shown in Tables V and VIII, and the central ages of the groups differ by half a year of age from those of the earlier experiences. It will be noticed that the mortality was light, but that, after the first two years of assurance, duration does not seem to have an important effect. This may be partly due to the large proportion of assurances accepted without medical examination.

In order to enable a better comparison to be made between the three experiences, Table IX has been calculated, giving rates of mortality at each quinquennial age. A comparison of Tables III and IV with Table V is awkward, because of the difference of half an age and because the average ages of groups having the same central age may differ. Table IX was found by calculating the average age for the groups and interpolating between the group rates of mortality to find the rates at each quinquennial age. In most cases the exposed to risk at each age were available, but a check can be placed on the figures by taking the tables where the exposed to risk are given in age groups and approximating to the average age of the group by calculating  $\frac{1}{2}(E_{+5} - E_{-5})/E_0$ , where  $E_0$  is the exposed to risk of the group for which the average age is required, and  $E_{+5}$  and  $E_{-5}$  are the exposed to risk for the next later and next earlier groups. This assumes that over the 15 years  $E_x$  can be expressed in the form

$$\int_{x-\frac{1}{2}}^{x+\frac{1}{2}} (a + bx + cx^2) dx.$$

In order to get rid of the “freak” minimum at ages  $35\frac{1}{2}$  to  $39\frac{1}{2}$ , and so make comparison a little easier, we have grouped all ages under 45 for 1924–38.

The rates of mortality have decreased continuously up to age 77; after that age there has been little change, but the middle experience is the heaviest.

#### *Mortality of insurance companies as a whole*

There have been four combined investigations into the mortality of assured lives in this country. The first was the combined experience of seventeen offices collected in 1838;<sup>6</sup> the second combined the experience of twenty offices up to 1863;<sup>7</sup> the third combined the experience of nearly all the assurance companies from 1863 to 1893,<sup>8</sup> and the last is the continuous investigation which began in 1924.<sup>11</sup> It may be mentioned that the Equitable did not contribute its experience to the first two combined experiences, though reference to it is made by the investigators of the 17 offices' experience, as mentioned on page 3.

The rates of mortality at quinquennial ages are given in Table X. The experiences relate principally to male lives, and the underlying methods of dealing with the statistics have already been indicated, except for the 17 offices' experience, which was practically the same as the one immediately following it. All the figures relate to assured lives accepted on normal terms; lives assured by

\*  $\frac{1}{2}(P_{x(n)} + P_{x(n-1)})$  gives the population as at the middle of the year at nearest age  $x$ ; i.e., between ages  $x - \frac{1}{2}$  and  $x + \frac{1}{2}$ ;  $\theta_{x(n)}$  gives the deaths between  $x - \frac{1}{2}$  and  $x + \frac{1}{2}$ .

industrial assurance companies in their industrial branches were not included. The rates of mortality for the 17 offices' experience are taken from the published lightly graduated rates, and for the experience that ended in 1863 are taken from the lightly graduated figures used for the well-known  $H^u$  and  $H^m$  <sup>(5)</sup> tables. For the 1863-93 experience figures are given that have been based on McTaggart's investigation,<sup>12</sup> which combined whole life assurances, whether the premiums were throughout life or limited to a maximum number of premiums and endowment assurances with and without profits. This course was adopted as it leads to a proper comparison with the 1924-38 experience, and is, in our view, more likely to be comparable with the Equitable experience, because the type of person which took endowment assurances with offices generally during the period 1863-93 took whole life assurances with the Equitable by a number of premiums limited to the term of endowment assurance that would have been taken elsewhere. Unfortunately there are no full-aggregate figures available for this experience.

McTaggart's tables give rates for quinquennial groups of ages similar to those shown in Tables III, IV and V in this paper, and also rates at individual ages. The average of rates of mortality for the five ages included in a group agreed closely with the group rates up to 55-59 group, and therefore give a good figure for the rate at the central age of the group. Thereafter, up to the 80-84 group, after which no group rates are given by McTaggart, the group rates understate the mortality at the central age because the exposed to risk is decreasing, and the average of the individual age rates overstate the mortality at the central age because mortality is increasing more in a geometrical than an arithmetical progression. The figures in the table may be regarded as the result of a very light graduation, and give, we believe, a proper estimate.

The last experience, 1924-38,<sup>11</sup> shows a considerable improvement in mortality, but to a small extent this is exaggerated. The contributing offices included all the assurances on male lives in the whole life and endowment assurance classes accepted on normal terms. Some offices, when premiums fall into arrear, grant automatically paid-up assurances—i.e., reduced sums assured free from future premiums—and some other offices continue the assurance until the premiums falling due after default have used up the surrender values. Especially in the case of the automatic paid-up policies the office may not hear of the death of the life assured, and it was discovered that there was an undue number of such assurances in force at advanced ages. This point has been discussed,<sup>13</sup> but it is difficult to make allowance for the error, and all that can be said is that, relatively to the deaths, the exposed to risk are overstated slightly, and consequently the mortality understated. The Equitable, in common with some other offices, keeps in touch regularly with the holders of all "paid-up" assurances, so the reader must keep a reservation in mind if he is comparing the mortality of an individual office with that of the offices as a whole. At the younger ages the point is unimportant, but would apply with increasing effect at ages over 60.

#### *Mortality of the general population*

Prior to Farr's famous English Life Table No. 3, which was based on the deaths for 1838-54 and the populations in 1841 and 1851, the information available for studying mortality is scanty and unreliable, but it seems advisable to give a few notes of some of the investigations that had been made.

For the most part all that was available was the record of burials, supplemented by information as to the number of christenings and marriages, and by



other general information regarding the total population—for example, the number of houses. The ages are unreliable, being merely the ages reported by the people concerned, and also the number of burials given is generally the number buried in the churchyards, and omits some burials of dissenters. Another difficulty arises from migration, as the towns were drawing many young people from the countryside. It could not, therefore, be said that the population in the towns was of a stationary character.

The London Bills for the years 1728–37 were collected, and tables based on these observations were produced by Thomas Simpson in 1742<sup>14</sup> and by James Hodgson in 1747,<sup>15</sup> but the latter made no adjustment for immigrants into London from the country. The table attributed by Price<sup>16</sup> to Simpson is not the one given in either of the editions of Simpson's book, but may have been produced by him at an earlier date.

The Bills for the years 1728–50 were collected by Corbis Morris.<sup>17</sup> Dodson worked out therefrom the table on which the original premiums were based when the Society for Equitable Assurance started in 1762. He seems to have increased the rate of mortality arbitrarily after about age 65, no doubt because the table was to be used for the purpose of assuring lives. He ended the table at age 86—the age assumed by De Moivre to be the limiting age.

Richard Price<sup>18</sup> examined more fully such evidence as existed as to mortality in various parts of this country. He calculated tables based on the London Bills of Mortality for the 10 years from 1759 to 1768, on the Northampton Bills for the years 1735–70 (and a second one, the famous one, on the Bills from 1735 to 1780), on the Norwich Bills for the 30 years from 1740 to 1769, and on various other data.

All the tables mentioned suffered from the defect that the statistics were not reliable, and that assumptions which we should now avoid had to be made in the construction of the tables. The persons concerned, however, adjusted for the errors so far as they could, and the results have been set out in Table XI as being of some interest.

There was, however, one table which, though it no doubt suffered from errors in age and possibly other errors in enumeration, was based on both deaths and populations. This was the table produced by Joshua Milne in 1815,<sup>19</sup> from the statistics of populations and deaths in Carlisle collected by Dr. John Heysham for 1779–87. We have included the rates of mortality in Table XI, but while they are much better so far as the method of construction of the mortality table is concerned, they have always been regarded as exhibiting, for one reason or another, exceptionally light rates of mortality.

The rates of mortality in the 18th century appear to be, and were, we think, much higher than the rates in the 19th century, but it is impossible to say how far any real improvement is distorted by the construction of the mortality tables from records of deaths alone and by the imperfections in the records of which mention has already been made.

The figures relate to both sexes combined, except in the case of the Chester Table.

From Farr's English Life Table No. 3 we are on safer ground so far as the construction of the mortality tables is concerned, and the main doubt about them is in respect of mis-statement of age. Rates of mortality at quinquennial ages are given in Table XII for males at dates which roughly correspond with those of the insurance experiences.

*Trend of mortality*

The rates of mortality for all ages showed a steady decrease, so far as the Equitable experience is concerned, up to about age 77. In the most recent experience the rates of mortality shown are about one-fourth of those of the first experience up to age 47 and rather less than one-half of those of the middle experience. The proportional fall decreases at the older ages until there is little change from age 82 onwards.

Arthur Morgan's statistics covered a very long period, during which the mortality of the lives assured had shown considerable changes, and we can give some idea of these changes with the help of William Morgan's calculations, to which reference is made in the introductory section of this paper. He gave for the twenty years from 1768 to 1787 a combined statement of the number at risk, deaths and the "number that should have died" (expected number of deaths by the Northampton Table) for groups of ten years of age. He separated whole life assurances from temporary assurances, and subdivided the latter into those effected for more and those effected for less than one year (possibly the last-mentioned group included the tail-end of the assurances originally effected for a longer period, but statistically the results are unimportant and we have neglected them in the tables we give). From 1788 onwards we have in William Morgan's MS. book \* figures for each year on the same basis, and these continued till 1814, when he discontinued giving figures as to term assurances, probably because they had become few in number. In Table XIII we give the particulars in groups of years and have included group rates of mortality. It will be noticed that the term business steadily decreased in importance, that the mortality under that business was higher than under the whole life assurances, and that the mortality of those assured for the whole of life showed an appreciable improvement during the period of over 60 years.

If we compare the rates of mortality shown for the combined insurance offices, excluding the first five years of assurance when the initial selection of lives has considerable effect, we see that the decrease from the  $H^M^{(5)}$  to the 1863-93 rates of mortality is less than that between the first two experiences of the Equitable, no doubt owing to the  $H^M^{(6)}$  experience relating to a much later date than that of the earliest Equitable table. The rates of mortality from the 1924-38 experience were only one-third of those of the 1863-93 experience up to age 37, changing to one-half at about age 50, and from age 77 onwards there is little difference between the two experiences. It must be remembered that while the 1863-93 and 1924-38 figures relate to nearly all the offices, those of the earlier experiences came from a relatively small number of offices and may not have been a random sample of the whole.

While we do not pretend therefore that the comparison of the combined offices' experiences gives more than a rough idea of the change in mortality of assured lives, it is all that is available.

There is little difference between the mortality of the various towns, except Carlisle, though all of them show a lighter mortality than London. The Carlisle mortality relates to later dates than the others, and is far lighter, it is about the same as the  $H^M$  and  $H^M^{(6)}$  tables up to age 62, and lower thereafter. The Carlisle Table was well known as showing a very light mortality in old age, and it was in consequence of this that it remained in use for annuity business till

\* A page of this book is reproduced in *J.I.A.*, LXIV, page 364.

late in the 19th century, and for valuing reversions even in the present century. The rates of mortality for all the tables mentioned above at ages over 70 must be regarded as even less reliable than those at the earlier ages.

When we come to the English Life Tables, we find that from the English Life No. 3 Table (which is a little earlier in date than the H<sup>m</sup> experience) to the English Life No. 5 Table (which is not much later than the Offices' 1863-93 experience) the mortality decreased by about one-quarter at the early adult ages and by about one-tenth between ages 30 and 40. From then onwards the English Life No. 5 shows an increase in mortality over that of the No. 3 Table, and even though the methods of construction and reliability differed, it seems probable that mortality actually increased. When we pass from the No. 5 to the No. 10 Table, which corresponds in date with the assurance offices' 1924-38 experience, we find a decrease of about one-half in the rates of mortality up to age 47, dropping to one-tenth at age 77, and showing on the whole a smaller decrease at the later ages. These changes are very similar to those between the two corresponding experiences of assurance offices as a whole, though the rates of mortality of the general population are, as we should expect, much higher than those of lives assured.

### Conclusion

The tables will, we hope, give some idea of the changes in mortality over a long period.

(1) From the Equitable experience we have an indication of the mortality of the professional and business people who have effected assurances over a period of 170 years.

(2) From the combined experience of insurance offices we have an indication of the mortality of the insured population (other than those who are catered for by industrial assurance alone) over about 140 years. This probably covers the more thrifty part of the community, and excludes those who throughout life are permanently unfit or in dangerous occupations. The experiences include some lives assured, who, though they had no intention of doing so when they effected their assurances, have subsequently gone into unhealthy occupations or to tropical countries.

(3) From the general population figures we know the mortality of the community as a whole.

We have to express our thanks to the directors of the Equitable Life Assurance Society for leave to publish the particulars of the Society's experience, much of which has not previously been available.

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## NOTE:

*J.I.A.* refers to the *Journal of the Institute of Actuaries*.

*T.F.A.* refers to the *Transactions of the Faculty of Actuaries*.

*J.S.S.* refers to the *Journal of the Institute of Actuaries Students Society*.

TABLE III  
1762-1829

Ages attained	Central age of group	Group Rates of Mortality						Aggregate excluding first to fifth years of assurance
		Aggregate all durations	Year of assurance					
			First	Second	Third	Fourth	Fifth	
— to 24	—	0.0084	0.0033	0.011	0.0063	0.010	0.0052	0.0080
25 to 29	27	0.0079	0.0035	0.0081	0.0079	0.0099	0.0062	0.0079
30 to 34	32	0.0083	0.0018	0.0067	0.0070	0.0090	0.0092	0.0098
35 to 39	37	0.011	0.0045	0.012	0.015	0.0096	0.0099	0.011
40 to 44	42	0.012	0.0037	0.011	0.010	0.011	0.012	0.012
45 to 49	47	0.014	0.0076	0.014	0.013	0.012	0.012	0.014
50 to 54	52	0.019	0.013	0.016	0.023	0.022	0.018	0.019
55 to 59	57	0.025	0.010	0.024	0.022	0.021	0.027	0.026
60 to 64	62	0.034	0.013	0.030	0.027	0.024	0.020	0.035
65 to 69	67	0.052	0.0098	0.032	0.053	0.033	0.046	0.053
70 to 74	72	0.074	—	—	—	—	—	0.075
75 to 79	77	0.104	—	—	—	—	—	0.105
80 to 84	82	0.136	—	—	—	—	—	0.136
85 to 89	87	0.184	—	—	—	—	—	0.186
90 to 94	92	0.290	—	—	—	—	—	0.312

Note.—There were entrants at ages over 70, including one at 88, but they were not sufficient to obtain rates of mortality. The "first year of assurance" was approximately one half-year and the "second year" ran approximately from duration  $\frac{1}{2}$  to duration  $1\frac{1}{2}$  and so on. The rates inserted for the first year of assurance are the rates for half a year.

TABLE IV

1863-1893

Ages attained	Central age of group	Group Rates of Mortality						Aggregate excluding first to fifth years of assurance
		Aggregate all durations	Year of assurance					
			First	Second	Third	Fourth	Fifth	
— to 24	—	0 0027	0 000	0-000	0-0031	0-000	0-0058	0-0083
25 to 29	27	0-0038	0-0035	0-0013	0-0032	0-0019	0-0068	0-0052
30 to 34	32	0 0056	0-0025	0-010	0-0028	0-0057	0-0071	0-0055
35 to 39	37	0-0068	0-000	0-0066	0-0047	0-0080	0-0048	0-0076
40 to 44	42	0-0072	0-0068	0-0023	0-0023	0-0088	0 0067	0-0076
45 to 49	47	0-010	0-0041	0-0037	0-0036	0-0071	0-0066	0-011
50 to 54	52	0-011	0-000	0-0068	0-000	0-000	0-0056	0-011
55 to 59	57	0-015	0-000	0-000	0-000	0 028	0-000	0-016
60 to 64	62	0 028	0 000	0-017	0 031	0-045	0-042	0 028
65 to 69	67	0-043	0-000	0 000	0-083	0 000	0-093	0-043
70 to 74	72	0 069	—	—	—	—	—	0-069
75 to 79	77	0-103	—	—	—	—	—	0-103
80 to 84	82	0-148	—	—	—	—	—	0-148
85 to 89	87	0-204	—	—	—	—	—	0-204
90 to 94	92	0-287	—	—	—	—	—	0-287
95	—	0-429	—	—	—	—	—	0-429

TABLE V

1924-1938

Ages attained	Central age of group	Group Rates of Mortality						
		Aggregate all durations	Year of assurance					Aggregate excluding first to fifth years of assurance
			First	Second	Third	Fourth	Fifth	
— to 24·5	—	0·0010	0·0012	0·000	0·0023	0·000	0·000	0·0013
25·5 to 29·5	27·5	0 0042	0·0056	0·0013	0·0029	0·000	0·0038	0 0062
30 5 to 34·5	32·5	0·0035	0·0020	0·0042	0·0011	0·0038	0 0028	0 0042
35·5 to 39 5	37·5	0 0013	0·0037	0·0012	0·000	0·000	0 0012	0 0014
40·5 to 44 5	42·5	0·0017	0·000	0 0014	0·0026	0·0026	0 000	0·0019
45·5 to 49·5	47·5	0·0040	0·000	0·0036	0·0035	0·0017	0·000	0·0047
50·5 to 54·5	52·5	0·0088	0·0053	0·0052	0·017	0·012	0·0070	0·0086
55·5 to 59·5	57·5	0·014	0·0043	0·011	0·026	0·024	0·020	0·014
60·5 to 64·5	62·5	0 021	0·000	0·032	0·0071	0·013	0·025	0·021
65·5 to 69·5	67·5	0·035	0·018	0·029	0·085	0·067	0·038	0·034
70·5 to 74·5	72·5	0·062	—	—	—	—	—	0·062
75·5 to 79·5	77·5	0·093	—	—	—	—	—	0·093
80·5 to 84·5	82·5	0·142	—	—	—	—	—	0·142
85·5 to 89 5	87·5	0·204	—	—	—	—	—	0·204
90·5 to 94·5	92·5	0·281	—	—	—	—	—	0 281
95·5 and over	—	0·444	—	—	—	—	—	0 444

TABLE VI

1762-1829

Ages attained	Central age of group	Aggregate		Year of assurance												Aggregate excluding first to fifth years of assurance	
				First		Second		Third		Fourth		Fifth					
		L	0	E	0	E	0	L	0	L	0	E	0	E	0		
— to 24	—	9,100	76	1,499.5	10	2,354	26	1,579	10	958	10	580.5	3	2,129	17		
25 to 29	27	14,366.5	114	1,727	12	3,071	25	2,528	20	2,021.5	20	1,602	10	3,417	27		
30 to 34	32	24,963.5	207	1,901	7	3,732.5	25	3,441.5	24	3,039.5	27	2,621	24	10,228	100		
35 to 39	37	32,927	365	1,766	16	3,535	43	3,363	49	3,120.5	30	2,925.5	29	18,217	198		
40 to 44	42	36,350.5	425	1,368	10	2,840.5	30	2,768	29	2,706.5	29	2,653	32	24,014.5	295		
45 to 49	47	35,894.5	496	1,047	16	2,140.5	29	2,125.5	27	2,064.5	24	2,038	24	26,479	376		
50 to 54	52	31,419	611	670.5	18	1,459	24	1,465	33	1,480	33	1,455.5	26	24,889	477		
55 to 59	57	25,173	639	434	9	915.5	22	938	21	951.5	20	957	26	20,977	541		
60 to 64	62	18,768.5	638	224	6	526.5	16	524	14	536.5	13	601	12	16,356.5	577		
65 to 69	67	12,204.5	631	51	1	157	5	228	12	272.5	10	285	13	11,211	590		
70 to 74	72	6,410	477	{ 4 }	{ 8 }	{ 7 5 }	{ 10 }	{ 38.5 }	{ 1 }	{ 6,366 }	{ 2,748 }	{ 896.5 }	{ 242 }	{ 32 }	{ 45 }		
75 to 79	77	2,764.5	288														
80 to 84	82	899.5	122														
85 to 89	87	244	45														
90 to 94	92	34.5	10												10		

Notes.—E stands for Exposed to risk, 0 for corresponding deaths.

The figures under "years of assurance" have been grouped together for ages over 70.

The "first year of assurance" was approximately one-half year and the exposed to risk is given in this table so that the columns can properly be added across to reach the full aggregate figures.

TABLE VII  
1863-1893

Ages attained	Central age of group	Aggrt gate	Year of assurance										Aggregate excluding first to fifth years of assurance	
			First		Second		Third		Fourth		Fifth			
			E	O	E	O	E	O	E	O	E	O	F	O
— to 24	—	2,213	6	—	416	—	327	1	242	—	174	1	482	4
25 to 29	27	4,708	18	—	743	1	624	2	524	1	439	3	1,526	8
30 to 34	32	8,013	45	3	770	8	719	2	705	4	698	5	4,331	24
35 to 39	37	10,275	70	2	608	4	633	3	628	5	619	3	7,188	55
40 to 44	42	11,261	81	—	428	4	442	3	453	5	451	3	9,048	69
45 to 49	47	11,344	114	3	267	1	278	1	280	2	301	2	9,974	107
50 to 54	52	10,917	118	1	147	1	157	1	155	3	180	1	10,137	116
55 to 59	57	10,419	157	—	92	—	97	—	108	3	113	—	9,924	154
60 to 64	62	9,717	274	—	60	1	64	2	66	3	71	3	9,398	265
65 to 69	67	8,448	365	—	27	—	36	3	39	—	43	4	8,286	358
70 to 74	72	6,988	480	—	—	—	—	—	—	—	—	—	6,976	479
75 to 79	77	4,798	493	—	—	—	—	—	—	—	—	—	4,798	493
80 to 84	82	2,802	414	—	—	—	—	—	—	—	—	—	2,802	414
85 to 89	87	1,268	259	—	—	—	—	—	—	—	—	—	1,268	259
90 to 94	92	356	102	—	—	—	—	—	—	—	—	—	356	102
95 and over	—	42	18	—	—	—	—	—	—	—	—	—	42	18

Note.—Select experience insignificant at ages over 70.

TABLE VIII  
1924-1938

Ages attained	Central age of group	Aggregate		Year of assurance												Aggregate excluding first to fifth years of assurance
				First		Second		1hrd		Fourth		Fifth				
E	0	E	0	E	0	E	0	E	0	E	0	E	0			
— to 24.5	—	3,141.5	3	823	1	597	—	431	1	297.5	—	208	—	785	1	
25.5 to 29.5	27.5	5,904	25	899.5	5	788.5	1	692.5	2	592.5	—	521.5	2	2,409.5	15	
30.5 to 34.5	32.5	8,335.5	29	985	2	963.5	4	870	2	793.5	3	715	2	4,008.5	17	
35.5 to 39.5	37.5	9,972.5	13	819.5	3	869.5	1	845	1	812.5	—	811.5	1	5,814.5	8	
40.5 to 44.5	42.5	11,564	20	742.5	—	732.5	1	758	2	764.5	2	725.5	—	7,841	15	
45.5 to 49.5	47.5	12,330.5	49	542.5	—	559	2	570	2	588	1	605.5	—	9,465.5	44	
50.5 to 54.5	52.5	11,636.5	102	380	2	388.5	2	401.5	7	404.5	5	427	3	9,635	83	
55.5 to 59.5	57.5	10,122.5	146	235	1	269	3	272.5	7	292.5	7	293.5	6	8,760	122	
60.5 to 64.5	62.5	7,873.5	162	104.5	—	125	4	141	1	150.5	2	163	4	7,189.5	151	
65.5 to 69.5	67.5	6,009	208	57	1	70	2	71	6	74.5	5	78.5	3	5,658	191	
70.5 to 74.5	72.5	4,400	271	—	—	—	—	—	—	—	—	—	—	4,400	271	
75.5 to 79.5	77.5	3,066	285	—	—	—	—	—	—	—	—	—	—	3,066	285	
80.5 to 84.5	82.5	1,727	256	—	—	—	—	—	—	—	—	—	—	1,727	256	
85.5 to 89.5	87.5	568.5	116	—	—	—	—	—	—	—	—	—	—	568.5	116	
90.5 to 94.5	92.5	156.5	44	—	—	—	—	—	—	—	—	—	—	157.5	44	
95.5 and over	—	18	8	—	—	—	—	—	—	—	—	—	—	18	8	
		96,825.5	1,737	5,588.5	15	5,362.5	20	5,052.5	29	4,770.5	25	4,549	21	71,502.5	1,627	

*Note.*—The figures under “years of assurance” opposite the age heading 65.5 to 69.5 relate to all ages over 65.5. There were few over age 70 and they could not conveniently be obtained separately. The aggregate excluding the first five years are correct but the figures for the full aggregate having been obtained from the other entries are approximate for all age groups over 65.5.



TABLE IX  
*Equitable Life Assurance Society*  
 Rates of Mortality ( $q_x$ )

Exact age	Full aggregate			Aggregate excluding first 5 years of assurance		
	1762-1829	1863-1893	1921-1938	1762-1829 *	1863-1893	1921-1938
22	0.0084	0.0028	0.0023	0.0080	0.0068	0.0027
27	0.0079	0.0037		0.0079		
32	0.0083	0.0055		0.0098		
37	0.011	0.0067		0.011		
42	0.012	0.0072	0.0040	0.012	0.0076	0.0047
47	0.014	0.010		0.014		
52	0.019	0.011		0.019		
57	0.025	0.015		0.026		
62	0.035	0.029	0.020	0.036	0.029	0.020
67	0.053	0.044	0.034	0.054	0.044	0.033
72	0.076	0.070	0.060	0.077	0.070	0.060
77	0.107	0.104	0.091	0.107	0.104	0.091
82	0.142	0.150	0.140	0.142	0.150	0.140
87	0.204	0.211	0.205	0.204	0.211	0.205

\* Excludes the first  $4\frac{1}{2}$  years of assurance approximately.

TABLE X  
*Insurance offices' combined experiences.*  
 Rates of Mortality ( $q_x$ ) Males \*

Age	Seventeen offices to 1884	Twenty offices to 1883		1863-92, excluding first five years of assurance (McTaggart)	1921-1938	
		HM	HM(-)		Aggregate	Excluding first five years of assurance
22	0.0075	0.0068	0.0103	0.0065	0.0018	0.0022
27	0.0080	0.0069	0.0099	0.0068	0.0019	0.0022
32	0.0088	0.0081	0.0093	0.0073	0.0021	0.0024
37	0.0097	0.0095	0.0107	0.0084	0.0028	0.0030
42	0.0109	0.0107	0.0116	0.0104	0.0039	0.0041
47	0.0135	0.0137	0.0144	0.0128	0.0056	0.0059
52	0.0180	0.0175	0.0188	0.0170	0.0087	0.0091
57	0.0247	0.0240	0.0251	0.0234	0.0140	0.0145
62	0.0351	0.0346	0.0356	0.0330	0.0232	0.0240
67	0.0515	0.0499	0.0510	0.0487	0.0383	0.0390
72	0.0758	0.0749	0.0756	0.0730	0.0635	0.0637
77	0.111	0.115	0.116	0.109	0.100	0.100
82	0.163	0.171	0.172	0.165	0.150	0.150
87	0.242	0.231	0.233	0.226	0.211	0.211
92	0.405	0.351	0.359	0.330	0.295	0.295

\* A small proportion of female lives were included in the first and last experiences.

TABLE XI  
General population, 18th century  
Rates of Mortality ( $q_x$ )

Age	London				Holy-Cross Shrewsbury	Northampton	Chester	Carlisle
	1729-37	1729-50	1759-68	1771-80	1730-70	1735-50	1772-81	1779-87
22	0.016	0.016	0.017	0.016	0.013	0.015	0.013	0.007
27	0.020	0.020	0.018	0.018	0.010	0.016	0.015	0.008
32	0.025	0.025	0.023	0.022	0.011	0.018	0.013	0.010
37	0.028	0.028	0.026	0.026	0.016	0.019	0.016	0.011
42	0.036	0.033	0.033	0.033	0.022	0.022	0.021	0.014
47	0.035	0.040	0.040	0.037	0.019	0.025	0.025	0.015
52	0.043	0.044	0.039	0.041	0.021	0.030	0.030	0.015
57	0.046	0.049	0.041	0.047	0.030	0.036	0.031	0.021
62	0.051	0.056	0.053	0.056	0.040	0.043	0.060	0.037
67	0.069	0.077	0.072	0.071	0.050	0.054	0.040	0.044
72	0.08	0.10	0.09	0.09	0.060	0.075	0.11	0.068

Notes.—Except in the case of the Carlisle Table the mortality tables were constructed in the form of the  $l_x$  column of a Life Table with a radix of 1,000 lives at age 0 in most cases, consequently the rates of mortality are rough. All the tables combined males and females except the Chester Table, for which only the rates for males are given above. The Chester Table shows wide variations in the "decrements," i.e., in  $d_x$  above age 60—we have used them as they appear in the original table.

TABLE XII  
General population, England and Wales—male lives  
Rates of Mortality ( $q_x$ )

Age	E.L. No. 3 1838-54	E.L. No. 5 1851-90	E.L. No. 10 1930-32
22	0.0086	0.0053	0.0033
27	0.0095	0.0072	0.0033
32	0.0105	0.0090	0.0036
37	0.0119	0.0111	0.0047
42	0.0138	0.0137	0.0064
47	0.0167	0.0171	0.0092
52	0.0212	0.0220	0.0129
57	0.0273	0.0294	0.0189
62	0.0371	0.0412	0.0287
67	0.0534	0.0581	0.0457
72	0.0785	0.0834	0.0725
77	0.114	0.122	0.113
82	0.162	0.178	0.169
87	0.223	0.255	0.241
92	0.294	0.354	0.320
97	0.37	0.46	0.42

Note.—E.L. No. 3 was constructed from the deaths in England and Wales in 1838-54 and the populations at the censuses taken in 1841 and 1851; E.L. No. 5 from the deaths in 1881-90 and the censuses taken in 1881 and 1891; E.L. No. 10 from the deaths in 1930-32 and the population at the census taken in 1931. The values of  $q_x$  have been given to the two or three significant figures.

TABLE XIII

*William Morgan's Equitable Life Assurance experience, 1768-1826*

Age	Whole life assurances			Temporary assurances for more than one year		
	Exposed	Deaths	Group rate of mortality	Exposed	Deaths	Group rate of mortality
1768-87 (20 years)						
-30	656	4	0-006	2,099	16	0-008
30-	1,986	23	0-012	3,203	44	0-014
40-	2,501	53	0-021	2,211	55	0-025
50-	2,024	58	0-029	1,005	35	0-035
60-	957	54	0-056	191	14	0-073
1788-96 (9 years)						
-30	1,610	7	0-004	3,041	21	0-010
30-	5,331	53	0-010	3,417	49	0-014
40-	6,143	87	0-014	2,837	40	0-014
50-	4,516	97	0-021	1,510	43	0-028
60-	2,028	65	0-032	382	17	0-045
70-	322	45	0-140	28	2	0-07
1797-1805 (9 years)						
-30	2,138	18	0-008	828	10	0-012
30-	7,651	52	0-007	1,790	22	0-012
40-	11,526	118	0-010	1,978	45	0-023
50-	8,953	166	0-018	987	22	0-022
60-	4,487	155	0-035	355	9	0-025
70-	949	86	0-091	22	2	0-09
1806-14 (9 years)						
-30	3,469	21	0-006	331	1	0-003
30-	13,151	81	0-006	677	5	0-007
40-	17,825	158	0-009	605	10	0-017
50-	15,281	242	0-016	505	5	0-010
60-	8,349	254	0-030	179	5	0-028
70-	2,239	181	0-081	12	1	0-08
1815-26 (12 years)						
-30	5,579	44	0-008	No particulars available		
30-	19,051	122	0-006			
40-	31,991	251	0-008			
50-	27,831	403	0-014			
60-	17,649	529	0-030			
70-	6,937	465	0-067			

*Notes.*—There is no evidence as to how Morgan calculated the Exposed. In his tables the heading is "No.", and the next column is headed "of whom died."

#### DISCUSSION ON THE PAPER BY SIR WILLIAM ELDERTON AND MR. OGBORN

PROFESSOR MAJOR GREENWOOD (from the Chair): Regard for truth prevents me from conforming to the traditional practice of movers of votes of thanks in our Society. It is possible that if this paper had been written differently it would have been a better paper. So many things are possible; but as I do not know how the case could have been better presented, I must simply thank

the authors for the pleasure and instruction they have given me and refer to some points in which I am particularly interested.

I infer from the authors' remarks that there has probably not been over the last century any great change in the social-economic differentiation of the assured population of the Equitable policy holders or, indeed, of those included in the combined experiences of the offices. So one has a record of changes affecting the two highest of the Registrar-General's social economic groups. Taking English Life Table No. 3 as a measure of the mortality of the whole population about a century ago and English Life Table No. 10 as measuring the general mortality of our own time, it is interesting to inquire whether the improvements in the selection and the whole population (of which the selected group is a small fraction) have proceeded *pari passu*.

The results suggest that they have not; the assured have improved at a faster rate. For instance, if one compares the rates of mortality at ages 42-57 shown by H.M. (5) with those of the combined experience of 1924-38 (excluding the first five years) the modern rate on assured lives is about 43 per cent. of the old rate; English Life Table No. 10 shows about 60 per cent. of the English Life Table No. 3 rate.

The general rate, starting higher, has improved proportionally less. This may perhaps be due to the large decline in the proportion of the general population employed or living out of urban areas. Farr, who did not live to see any substantial improvement in general rates of mortality, made this point. The general lack of improvement in rates of mortality at advanced ages is interesting. One often hears of the increased length of human life. If those who speak and those who listen mean by this that a much larger proportion of live-born children grow to be men and a larger proportion of young men (in peace time) live to be eligible for minor political office, the statement is true. But I am not at all sure that *is* what is understood. I think it is believed that the Psalmist's term of three score years and ten has been considerably advanced and that Mr. Shaw's *Back to Methuselah* only exaggerates a little what is really happening. The evidence of this paper does not support that view. Neither the Equitable experience nor the combined experiences suggests any secular change in rates of mortality at ages over 32. I am aware of the material and statistical difficulties of studying rates of mortality at advanced ages but it is an attractive subject.

Some years ago Dr. E. J. Gumbel reached an interesting paradox. Writing  $l(x) = \int \theta(x) dx$ , where  $\theta(x)$  is the probability that a newborn child will die between the ages  $x$  and  $x + dx$ , the probability  $w_N(x)$  that the eldest of  $N$  descendants is not older than  $x$  is  $(1 - l(x))^N$  and the density of probability  $w_N(x) = N(1 - l(x))^{N-1} \theta(x)$ .<sup>\*</sup> If  $\zeta$  is the age for which  $\theta(x)$  is a maximum and  $l(x)$  the expectation of life at age  $x$ , Gumbel's paradox is this. If we have two tables of mortality following the same law and  $\zeta_1 > \zeta_2$  but  $l(\zeta_1) < l(\zeta_2)$ , the modal age from (1) for the former table will be less than for the latter table. In other words, the oldest survivor of the more favourable table will be younger than that of the less favourable table.

Dr. Irwin and I verified Gumbel's algebra. It seemed to us, however, that *sensu stricto* two populations for which the  $\zeta$ 's differed widely were unlikely to follow the same law.

Perhaps it is not too pessimistic to say that no one table has followed the same law even when the origin of  $x$  is taken in adult life. We talk less of survival of the fittest by natural selection than when I was young, but there is evidence provided by many biometricians, notably Raymond Pearl, that length of life partly depends on a hereditary factor. If so, as  $x$  increases, the *quality* of the exposed to risk changes. Dr. Irwin and I made some experiments on the scanty data available to us, in order to see whether the function  $d_x$  could be graduated by an infinitely compound Poisson series, so useful for accident

data. This "law" would imply, *inter alia*, that  $q_x$  tended to an upper limit less than unity. For various reasons a negative binomial could not really be the true "law," but might give a fair approximation. It did graduate effectively enough two sets of, respectively, 50 male and 240 female annuitants (National Debt Office) who attained the age of 90 in 1920-22 and were observed until death. The limiting values of  $q_x$  were 0.439 for women and 0.544 for men. Of course, so trifling an experiment proves no more than that the analogy is not preposterous. The study of a really large experience of exposed to risk observed from age 90 would be of great interest. In the nature of things, the very aged are shielded from many of the accidents of active life. Even in the higher ranks of the medical and legal professions few men take very active parts after the age of, say, 85. Students have often tried to construct an order of dying out when accidental or humanly preventable causes of death are excluded; they have not been successful because of the ambiguity of the terms. The mortality table of the very aged might throw some light on natural mortality.

SIR GEORGE EPPS (Government Actuary), in seconding the vote of thanks, said: This paper is of great historical interest and includes a mine of information for students. The particular interest, I think, in William Morgan's early researches lies in the modernness of his approach and especially in his treatment of selection. The authors have given us a variety of data, and it occurred to me that it might be of interest to round off the picture by mentioning some of the experiences of government life records which have been kept from the end of the seventeenth century in respect of lives that were entitled to benefits in certain Government tontine and sinking funds. John Finlaison's report of 1829\* contains voluminous tables and experience of a great number of successful tontine and sinking funds. John Finlaison, you may remember, was the first of a famous family in the National Debt Office, and more than 20 years after he published this report he became the first President of the Institute of Actuaries, which office he held for 12 years (1848-60). I should like to give you a short extract from his report, as indicating the type of report in those days presented in Government circles. He said that he had the honour of presenting 22 original investigations "in each of which the facts or data are so arranged as to be easily intelligible to all who take an interest in this branch of science." He then went on to say, that with a view to attaining the utmost perspicuity by means of familiar illustrations he had "ventured to deviate from the ordinary official style in which your Lordships are properly addressed," and it was therefore necessary, he added, to detach these observations from the report altogether "in the hope that your Lordships would be pleased to receive them merely as the notes of a literary man." In conclusion he besought their Lordships to acquit him of intentional failure in respect or duty by so presenting them, "all which is nevertheless most humbly submitted to your Lordships' superior wisdom."

Coming back to the experiences of the Government's annuitants, we have this series of the eighteenth-century tontines combined in a single experience on which Finlaison reported in 1829. Then his son, Alexander Finlaison—or it may have been his nephew—brought together all the observations from 1773 to 1856, and A. J. Finlaison, another member of the family, in 1884 gave a further long-series table down to 1875. The next experience was a little later, but of the same span as the Life Offices' experience, 1875-1904, and then the latest was from 1900 to 1920.

I should have thought *prima facie* that from the nature of the data the distortion owing to errors of age would be very small or not present at all, and it seems to me the most remarkable thing that the first four tables I have referred to show remarkably little improvement at all in mortality, the change occurring in the most recent. For example, take males at age 67: in the first four experi-

\* "Life Annuities." Report of J. Finlaison, Actuary of the National Debt, on the evidence and elementary facts on which the tables of life annuities are founded.

ences the rate of mortality was almost exactly 5 per cent., and then it dropped to 4 per cent. in the last table, namely, the 1900–20 experience. Similarly, at age 57 there was only a very small decline from the eighteenth or early nineteenth-century experience—from less than 3 per cent. to about  $2\frac{1}{2}$  per cent. (1875–1904)—and again a large drop of about  $1\frac{1}{2}$  per cent. in the 1900–20 experience.

I think that a study of these twenty-two observations in the 1829 report of Finlaison, all of them relating to tontine or sinking fund arrangements, might well bring out some most interesting results, and I commend it for examination at some later date.

With regard to the mortality in the Offices' experiences, it would be interesting to know whether there is any special reason for the particularly light rates shown for the Equitable in middle ages. For example, in 1924–38 the full aggregate rate for age 47 was, in the Equitable, .0040, and, in the combined companies, .0056, or 40 per cent. in excess, where at ages 57 and 67 the excess was roughly 10 per cent.

There is one other matter to which I should like to refer very briefly, namely, the comparison in the paper of the three English Life Tables, Nos. 3, 5, and 10. This, of course, brings out clearly the three factors: the progressive improvement at all the younger ages, the relative fluctuations between Nos. 3 and 5, and then the reduction in No. 10 at the middle ages. Finally, for the older ages the noteworthy increase of mortality rates from Table No. 3 to No. 5, with the recovery in No. 10. I am aware of the suggestion that Farr's English Life Table made an under-statement for the advanced ages. This was examined in a paper read before the Institute of Actuaries in 1908, but the differences brought out by an alternative construction were not very important except at the extremely advanced ages of 80 and over. Therefore one is left rather wondering how that feature arose.

As to the trend at the later ages, I went back to the Registrar-General's Statistical Report for 1937, in which he gives the mortality rates per thousand population at various age groups, and I took out the figures from 1841 to 1930. I took two groups, a middle and a late one for males. For ages 35 to 45 I observed that the mortality from 1841 to 1880 showed a death rate of 12.9 per 1000, with a small drop in 1851–60, substantially higher rates in the 'sixties and 'seventies, then a drop in the decade 1881–90, which, of course, is the period covered by English Life Table No. 5, and then a progressive drop from the 'nineties into the present century. Taking the ages 65 to 75, thirty years older, there is a progressive increase during the period 1850–90, and with again the highest value in the period corresponding to English Life Table No. 5. It is not until the beginning of the new century that there is an appreciable drop in the older mortality, the period 1891–1900 being as high as that of the preceding twenty years.

The suggestion I would make is that an actual change in the vitality of the middle and later ages is really a phenomenon of the twentieth century, and that there was not, apparently, a progressive improvement throughout the second half of the nineteenth century.

The position in the present century seems to me to be badly disturbed by, amongst other things, the two wars. This, of course, makes any forecast of the future trend of population on the basis of extrapolation from recent past experience a peculiarly speculative matter. In conclusion, I might perhaps mention the difficulty one has in looking backwards on the Life Offices' experience of both assured lives and annuitants, owing to the fact that our predecessors seemed to rely more on large data than on shorter periods. It is to me extremely tantalizing that both the Government annuitants' experience and the Offices' experience did not break up their periods. It is quite impossible to form any judgment as to whether the series of mortality rates during that long period of thirty years, 1863–93, was fairly flat or not.

MR. H. E. RAYNES said that the Government Actuary had expressed some doubt whether there had been a consistent improvement in the mortality

throughout the period under review. From the figures given by the authors in Table No. 12, relating to the experiences of the third, fifth and tenth tables, it was apparent that there was not a great discrepancy in the mortality shown in Table No. 5 as compared with No. 3, but that there was a considerable improvement in No. 10 as compared with No. 5.

The present discussion concerned three classes of mortality: that shown by the Equitable, that shown by other Life Offices, and that shown by the general population. The Equitable figures were most consistent throughout its period. Those of them who had some familiarity with the office in question knew that it had pursued the same policy throughout its long history. Its business had been confined to the better mercantile class and the professional class, but later had included also the scholastic class. It had never been subject to rapid or very large expansions. One would expect therefore that the mortality in the experience of that institution would be distinct from that of the other combined Life Offices and that of the population in general. With the Equitable one had a confined area practically throughout the whole period of its existence, whereas the other Life Offices had rapidly expanded in respect of the classes of insured persons whom they had taken in. They had started perhaps in their earlier periods with the well-to-do and professional classes, and had widened the area of their insured lives until they had included a proportion of wage earners.

Then, again, in comparing the mortality of insured lives with that of the general population it must be remembered that a sort of process of selection was going on throughout. It might be surmised that there was a tendency on the part of the assured person to make a special effort to retain his policy whenever he was in bad health, and withdrawing, if he thought it necessary, only when in full health.

There was one feature of the mortality in Table 5 to which the authors had not referred. In the first two experiences mortality consistently increased with the age (except for the first group in the first period) but in the third period it decreased for ages 27 to 37. (See Tables 3, 4 and 5.) An analysis of the series of English Life Tables from No. 6 (1896) to No. 10 (1931) shows a substantial improvement during this period as compared with the small improvement between No. 3 (1846) and No. 5 (1886). I have made a Table of those who died within 10 years out of 1000 alive at certain decennial ages:

*Numbers dying within 10 years following attainment of certain ages.*

Age.	Table and Central Year.				
	No. 6. 1896.	No. 7. 1906.	No. 8. 1911.	No. 9. 1921.	No. 10. 1931.
0	266	219	188	143	110
20	54	44	39	38	32
40	137	115	102	84	76
60	398	371	358	328	318
80	923	895	888	886	900

No statistics of human welfare are so definite in their interpretation as those relating to mortality. I think the later population table shows what many of us would have expected who can remember their early years in the 'nineties of the last century. Personally I can remember vividly from my boyhood conditions in a Nottinghamshire mining village in the early 'nineties, and can contrast conditions then with those revealed in a visit made there 40 years subsequently. I can also call to mind the conditions in London in the 'nineties and can contrast them with those of 1931. The contrast is that

revealed by the improvement in mortality in the No. 10 Life Table over that in the No. 6.

As to the lack of improvement in mortality at the old ages, I do not think that any very satisfactory explanation has yet been furnished. A limited explanation has been given in the Report both on the No. 9 and No. 10 Tables on pages 10 in each of the Reports.

MR. H. E. MELVILLE (President of the Institute of Actuaries) said that the authors had given a comparison of mortality rates over a long period and for various classes of the community. In spite of the defects in some of the tables to which their attention had been drawn, they could agree that the broad picture had been put in its right perspective. Like Sir George Epps, he had been interested in the early attempts to measure select mortality rates. Morgan's Table apparently showed that select mortality, that is, the light mortality to be expected in the early years of assurance owing to the fact that a man must pass the doctor when he proposed for insurance and must be a good life, did not last very long. The Institute of Actuaries' experience of 1863-1893 showed a totally different picture. There, apparently, selection was quite significant over a substantial period and in the Tables finally published the selection was extended over a period as long as ten years. He thought that during that period 1863-93 there was evidence of a distinct improvement in mortality going on all the time. By taking the whole of the data for those thirty years they were mixing like and unlike; the data were not homogeneous, and statistical distortions arose. He thought that the evidence of selection lasting over so long a period as 10 years was more apparent than real.

By now they had learned the importance of examining mortality statistics over comparatively short periods, and the standard insurance tables of today, based on the period 1924-29, show that after the first few years the influence of selection is of little practical importance. Even before these 1924-29 tables were published it was obvious that the older tables were obsolete, because the population rates were actually less than the rates shown by the insurance Tables then in use, and when, some twenty years ago, he had wanted to get some information about the mortality of professional and middle class lives, he had difficulty in obtaining anything at all appropriate.

To-day, however, they had available a continuous examination of the mortality of insured lives, according to the class of policy concerned, the class of office, and so on, and were in a much better position than they had ever been before to watch the changes in mortality which, he believed, were still taking place.

It was possible now to look back over a considerable period during which there had been a substantial improvement in mortality at most ages, and he was optimistic enough to believe that that improvement was going to be continued and that sooner or later it would extend to the older ages where, as had been pointed out, there had been little improvement so far.

But while they had these modern tables and were well equipped in their day-to-day work, it was amazing to note how long it took for some of the old tables, once standard and now obsolete, to go out of use. Only recently in one branch of a Government department he had found the old Northampton table of mortality being used and in another the Carlisle table. In each case the people using the tables had no idea that they were obsolete, but the unfortunate effect of their calculations, if these had not been challenged, was that the public would have been paying a good deal more in stamp duty than they ought to have done.

The authors were fortunate in being associated with an Office which not only laid the foundations on which modern life assurance has been built but had kept its records and had made them available. He himself was associated with an Office which, although young in comparison with the Equitable, was nevertheless more than 100 years old, but no records bearing any comparison to what had been given in the paper were available in respect of that Office.



The Equitable was fortunate also in having had in its service a line of able actuaries, of whom not the least were the present authors.

MR. DERRICK (Deputy Registrar-General) said that his main interest in the paper was rather the inference that might be drawn from it in regard to future trends. The Equitable experience was a somewhat special one, brought about, no doubt, by a conservative and very careful selection of its clientele, and the fact that the mortality was very much lower than that of the other British offices and of the population as a whole was to be expected. What seemed more surprising was that the British Offices' experience continued to be as relatively favourable as it appeared to be. As Mr. Raynes had pointed out, the character of the business of these offices changed considerably over the period of review. To-day they worked under keen competitive conditions and frequently paid large commissions for their business. Their operations had been extended to cover ever wider sections of the population and their more recent experience—after the effect of the initial medical selection had passed away—might well have been expected to reflect mortality conditions corresponding more or less to those of the higher social classes in the national population such as were distinguished in the Registrar-General's statistics. But the former were consistently more favourable and it was difficult to account for the difference, which was of the order of 20 per cent. At the early ages of insurance it might possibly be explained by the inclusion in all classes of the national population of numbers of lives which were not insurable, but he would have thought that that would have disappeared largely towards the older ages. But even beyond age 75 the combined Offices' experience was more than 10 per cent. below the national experience and that of the Equitable considerably lower still.

It was perhaps relevant to observe that light mortalities corresponding to those of our insurance offices had been attained on a national scale in the Scandinavian countries, Australia and New Zealand, while in the Netherlands the values before the war approached those of the Equitable. In this respect our own national experience did not stand in an altogether favourable light, though there seemed no reason why more promising results should not be forthcoming in the future. The Registrar-General's forecasts of future improvements in mortality had been criticized as unduly optimistic, but the experiences of other countries and of the large insurance sections of our own population now before us clearly showed that the lower rates contemplated were not beyond attainment and there was every hope therefore that they would be achieved in the not too distant future.

MR. B. BENJAMIN said that as an official in the public health service he was particularly pleased that this paper had been presented. It was sometimes difficult for public health officials to detach themselves from immediate emergencies and to study in perspective the present and future trends. The great improvement in public health services which had taken place during the past century was reflected in these statistics which showed what an important effect upon the mortality tables of posterity any present day improvements might have, such as, for example, the reduction of the incidence of diphtheria, which was a large cause of child mortality. This study therefore gave to the public-health worker an incentive to increase the efficiency of his service.

Other things which he would have liked to have said had been covered by previous speakers, and he would add only an expression of gratitude that this experience would be safely put on record in the annals of the Society. To a statistician not engaged in an insurance office, it was of very great value thus to gain access to the experience of the Equitable.

MR. P. G. BROWN said that the improvement which had taken place in mortality at all but the oldest ages during the last forty years was seen not only in the English Life Tables, but also in other population tables. It was almost

equally marked in the life tables for Scotland, and not much less so than those for Glasgow. Indeed, it seemed to be quite a universal feature in all the experiences during that period.

A good deal had been said about the mortality of the older ages, and reference had been made to the fact that in old age there had been little change during the last 100 or 150 years. But was that altogether surprising? Professor Greenwood had mentioned the biblical reference to three score years and ten or four score years at most, which still remained a reasonable estimate of the span of human life. The fact was that the human frame was not constructed to last for an indefinite period. The natural tendency for the body to wear out, operating on an ever-increasing proportion of the population whose lives had been prolonged by improvements in medical science and other favourable developments, might well have the effect of keeping the death rates at advanced ages more or less stable.

He had known only one person who was a near-centenarian. This was an old lady who was 97 at the last census, but insisted on putting her age down as 100, explaining that in any case she would be 100 when the results of the census were published! But that sort of thing was presumably much less common now than it used to be. It was possible that in the past even at the advanced ages there had been some actual improvement in mortality which had been concealed by a contemporaneous and equivalent decrease in misstatements in the statistics.

It might well be that some of the plans which were now under consideration for ameliorating the conditions of the life of the people might incidentally have the effect of increasing their vitality.

The following contributions were received in writing:—

Mr. J. G. KYD (Registrar-General for Scotland): I appreciate most highly the action of your Executive Committee in sending me a proof of the paper by Sir William Elderton and Mr. Ogborn on the mortality of adult males since the middle of the eighteenth century. I am sorry that pressure of official matters renders it impossible for me to be present at the meeting in London on Tuesday. I am sure that statisticians generally, and actuaries in particular, owe a debt of gratitude to the authors for displaying in such readily available form particulars from which mortality trends among adult males can be measured. I am particularly interested in the relation between the improvement in mortality among the general population as shown in the English life-tables and that shown by the experiences of the combined Assurance Offices. A comparison shows that in fifty years or so the improvement in mortality among assured lives as evidenced by the Offices' experiences—excluding the first five years—is materially greater at the earlier ages than that in the general population, but that in the higher age-groups the general population appears to show a rate of improvement very similar to that among assured lives, although the actual rates of mortality in the general population were with one insignificant exception always greater than among assured of that same age.

Does this mean that while both the assured lives and the general population have benefited from the measures to improve public health and hygiene the greater improvement among assured lives at the earlier ages—when the majority of assurances are effected—is due to the increasingly superior methods now adopted by the Offices, and their medical advisors, for rejecting all but the best lives? Further, it would seem that the effects of this selection lasts considerably longer than the first five years after acceptance.

If this view is correct, it seems to me that a considerable part of the improvement in the mortality of lives assured as shown in the 1924–38 Offices' experience compared with that in MacTaggart's investigation is due in no small measure to the superior selection now exercised by the Offices.

It would be interesting to obtain mortality rates experiences among the policy-holders of industrial assurance companies during the later decades of last

century, and compare them with those experiences among the same class during the few years immediately before the outbreak of the present war. I should think that the mortality trend would be nearer to that among the general population than to that experienced by the policy-holders in ordinary Life Offices.

MR. W. W. WILLIAMSON: It may be of interest to record that Mr. Charles Brand in 1779 compiled a table of the duration of lives from data derived from the old Amicable Society from its institution in 1706 to 1777, both inclusive. This table, given in Volume I of Walford's *Insurance Cyclopaedia*, is therein stated to be the first "experience" table. I am afraid that it will hardly meet with modern actuarial approval, as the data were apparently entirely derived from the deaths, no account being taken of survivors. Thus the figure of 15·9671 appearing opposite age 30 represents the average duration at death of policies effected at age 30 and which had become claims. The table of expectation of life is even more unscientific in its compilation. Having obtained an average duration of 6·7671 for policies on the lives of people entering at age 62 or over, Brand assumed this as the expectation of life of this group, and to obtain the expectation of life at any previous age he added to each duration 1 year for each year elapsed. Thus the expectation for the group 56 to 62 was obtained by adding together 8·2585 and 7·7671 (6·7671 plus 1) and dividing the result by two. Again, using age 30 as an example, the "expectation" at that age was found by adding together all the "durations" from 30 to the end of the table plus the sum of the natural numbers from 1 to 27 inclusive (there being 27 subsequent ages or groups of ages), and dividing the result by 28, arriving at a figure of 27·6980.

Also, it may be of interest to note that in 1841 Mr. Galloway, the then Registrar of the Society, published the experience of the Amicable for a period of 33 years from 1808 to 1841. This table would appear to have been based on sound principles and as bearing on the interesting paper submitted by Sir William Elderton and Mr. Ogborn it may be noted that Galloway apparently adopted the methods of W. Morgan, the Actuary of the Equitable. Galloway in his table made reference to the effects of "selection" and in comparing his results with those of the Equitable found that the Amicable mortality was more favourable for ages between 25 and 40, while the reverse was the case from 45 to 60, the difference, however, being inconsiderable. Above age 60 the mortality for the Amicable increased rapidly in comparison with that of the Equitable and was less favourable from age 65 than the figures of the Northampton table.

Anyone particularly interested in the actual figures will find those of Mr. Brand and Mr. Galloway in the Walford's Volume referred to above, while more detailed information in respect of Mr. Galloway's investigation will be found in Volume II of *Value of Annuities* by David Jones, 1843.

MR. M. E. OGBORN, replying to the discussion, thanked Professor Greenwood and the various other speakers for their kind references to the paper.

In the paper itself the authors had kept to the statistics, and had not gone into the reasons for the improvement in the mortality, because these were not capable of exact determination. An improvement in social conditions had been mentioned by Mr. Raynes and other speakers. Those who read contemporary novels which gave a picture of the life of the times would readily appreciate what this change in conditions meant. Then there was the improvement in medical science, which had been a real factor in reducing mortality. He thought that the reduction was to be explained primarily by the improvement in medical science, including preventive as well as clinical medicine.

A lag in the improvement was caused by the change over from residence in rural to residence in urban areas. The mortality in urban areas had always exceeded that in rural areas. On that point it might be a matter for enquiry whether the increase in mortality at the older ages in the third quarter of the last century, when much of this transition was taking place, was in fact a real one. He would not be prepared himself to say whether it was real or due to

various errors, but one explanation might lie in the increase in the proportion of the population living in urban areas.

Sir George Epps had referred to Finlaison's experience. The authors had considered including the Government annuity experiences, but had omitted them in order to save overloading the paper.

Sir George Epps had asked whether the entrants in the Equitable were rather older in age than the average for offices at the present time. He did not think that was the case.

The rates in early life showed the most striking improvement, mainly due in his opinion to the advances in medical science. Considering the older ages, which had been an interesting point in the discussion, he had taken out the rates of mortality at age 72. In the Northampton table, which was dated the middle of the eighteenth century, the rate of mortality at age 72 was 0.075. In English Life Table No. 3 it was 0.0785, in No. 5 0.0834 and in No. 10 0.0725. The rate of mortality at age 72 had apparently not improved, and might even have worsened up to the end of the nineteenth century, and, as Sir George had said, the real improvement was in the twentieth century. Taking the experience of the twenty Offices, the Equitable experience, and the experience of the 1863-93 tables, up to the end of the nineteenth century, the results for this age were all about the same, and he did not think it could be said that there was any significant difference between any of them.

As to whether the "span" of life had been increased, he thought that the best general way to look at this was to take the age at which the maximum number of deaths occurred according to the life tables. That might be described as the most likely age of death. Excluding infancy, according to the most recent assured lives experience the most likely age of death was 75, according to the 1863-93 experience it was 73, and according to the earlier twenty Offices' experience it was 74. Taking the latest population experience the most likely age was, for male lives, 74. That was rather interesting, because over the same period the expectation of life at birth for males had increased from 40 years in the case of English Life Table No. 3, to 58 years in the case of English Life Table No. 10. Notwithstanding the increase in the average duration of life, there had not been an increase in the "span" of life. After all, that was reasonable. Much of the mortality at the young and middle ages was due to diseases about which the medical profession learned more every year and for which new remedies or new methods of prevention were constantly being found, but at the older ages it was more a question of exhaustion of vitality. Until doctors learned more about the innate vitality of people and the ways in which this could be increased, he did not think personally that a large extension of the "span" of life would be realized.

There was an aspect of the improvement in mortality which had not been mentioned in the discussion, namely, the effect on the total population. It had been estimated that the population of England and Wales was of the order of six millions or rather less in 1701. By 1801 it was about nine millions. By 1901 it had become about thirty-two millions. Why did that increase occur? Was it due to increased fertility or to the longer average lifetime? It might be that the increase was due as much to increased vitality as to increased fertility.

On behalf of Sir William Elderton and himself he thanked the members for their kind reception of the paper.

SIR WILLIAM ELDERTON also wrote in reply, as follows:—

With reference to Mr. Raynes's remarks it is true that the Equitable pursued the same policy in that it did not pay commission or employ agents, but it cut down new business in the early nineteenth century so that in the middle and latter part of that century it was something like an approximation to a "closed fund." Then its policy changed and it grew a little from 1890 to 1913, and after the last war its expansion has been proportionally greater than that of most of the

offices. Although there was not a conscious "conservative and very careful selection of its clientele" (see Mr. Derrick's remarks), the type of person to whom an insurance company of this kind appeals has changed slightly if at all. It is probably a better clientele from the mortality point of view than that of the Offices as a whole, but I do not think that the actual selection from those who proposed for assurance was different from that of other offices.

I should, personally, answer Mr. Kyd's question by saying that the Offices' experiences relate on the average to a provident type: the lives assured who are or become improvident tend to surrender their policies because they cannot or will not find the money to pay their premiums and are glad of any cash surrender value they can get. I think he is right in his suggestion that the Offices have learnt something as to the selection of lives, but the recent practice of accepting individual lives, or groups of lives, without medical examination may have obscured this increased knowledge in the statistics.

In connection with Sir George Epps's remarks as to age 42 and Mr. Raynes's remarks as to ages 27 to 37, the warning may be given that the numbers of deaths in these groups are small and the existence of more than one policy on some of the lives makes it difficult to estimate the extent of chance deviation.

In addition to the remarks made in the paper and above, it may be mentioned for the sake of anyone who tries to compare changes in the mortality in the Equitable experiences with changes in the Offices' mortality that (i) the recent experiences of the Equitable contain a larger proportion of cases not medically examined than that of the Offices as a whole and (ii) there is a lower "withdrawal rate" in the Equitable, *i.e.*, relatively fewer "surrenders" (there are practically no "lapses"), as compared with "surrenders and lapses" in the Offices generally.

As a result of the ballot taken during the meeting, the candidates named below were unanimously elected Fellows of the Society:—

Noah Barou, Ph.D.  
 John Baxter.  
 Ivor Ian Bowen.  
 Eileen Minnie Brooke, M.Sc.  
 Frank Reginald Cashmore.  
 Joseph Rosslyn Clementson.  
 Eric Keith Coles.  
 Thomas Edward Cowan.  
 William Francis Darke, Ph.D., B.Litt.,  
 B.Sc.  
 Reginald Charles Ward Davey.  
 John Henry Dobson.  
 Edward Charles Dodds, M.V.O., M.D.,  
 D.Sc., F.R.S.  
 Hassan El-Saaty.  
 William Ernest Franklin.  
 Frank Adzley Friday.  
 Louis Gaughan.  
 Hilton Gillender.  
 William Graham Gooda.  
 Charles Dunn Hardie.  
 Arthur Emrys Jones.  
 Peter K. Kaim.  
 George Robinson Kensit, B.A., F.I.A.  
 Richard Edmund Killick.  
 Elizabeth Lessof, B.Sc.  
 Paul Michel Gabriel Lévy.  
 Grace Gwendoline Leybourne, Ph.D.  
 Sir Lynden Macassey, K.B.E., K.C.  
 Mary Sullivan McLean, M.A.  
 Robert Alan Russell MacClelland.

William T. McVittie.  
 Alfred Maizels.  
 Donald Beattie Martin, F.I.A.  
 John Gordon Craig Milligan, B.Com.  
 Boleslaw Monic.  
 Maurice Edward Ogborn, F.I.A.  
 Oliver Reginald Opie, B.Sc.  
 Ouchterlony of Kellie, Baron.  
 Harold Parkinson.  
 Stanley Clifford Pearce.  
 Charles Clarke Puckette.  
 Ronald Ernest Robertson.  
 Daniel Herbert Roper, F.C.I.S.  
 N. Sarkar, M.A.  
 Joseph Maxwell Signy.  
 Gordon Leslie Simpson.  
 Alexander Stuart Vernon Skilton.  
 Charles Alexander Smith, LL.M., F.C.A.  
 Ivie Alexander Speirs.  
 L. G. K. Starke, B.A., F.I.A.  
 Albert William Swan, B.A.Sc. (Toronto).  
 Alfred Thompson.  
 Heinz Werner Tomski.  
 John Unwin, LL.B., F.C.A.  
 Stefan Vajda, Dr.Phil.  
 John Joseph Vincent.  
 Edith Holt Whetham.  
 Thomas Williams.  
 James Harold Wilson.  
 Fred Woodcock.  
 Glenn Wortley.

*Corporate Representatives*

Collingwood Hughes, *representing* The London Express Newspapers, Ltd.

Herman Jaffe, *representing* The Norwegian Shipping and Trade Mission.

George Krajewski        }  
Wieslaw Szymkowiak } *representing* The Polish Maritime Council.

Mathias Artur Georg Landau, *representing* The Association for Planning and Regional Reconstruction.

Oscar Margulies, *representing* The Pallas Oil and Trading Company, Ltd.

Hannah Neustaetter, *representing* The Trades Advisory Council.

Aake Ording, *representing* The Royal Norwegian Ministry of Supply and Reconstruction.

Miroslav Turek, Lt., *representing* The Czechoslovak Ministry of National Defence.

Allan Stuart Wharton, *representing* Philips Lamps, Ltd.

## THE FUTURE OF AGRICULTURE

By R. J. THOMPSON, C.B.

[Read before the ROYAL STATISTICAL SOCIETY, April 20th, 1943,  
MR. H. LEAK, C.B.E., in the Chair.]

THE future of agriculture in this country obviously depends on many circumstances and conditions which are at present unknown, but planning is in the air, and it is perhaps an appropriate time to consider some of the factors involved and the directions in which a solution of the "agricultural problem" may be found.

There have been in the past two main attempts at an agricultural policy. The first was that of leaving agriculture to find its own level in competition with the agriculture of other countries. This, broadly speaking, was the policy adopted by this country up to about 1929. The second was a method of assistance to agriculture by way of tariff protection combined with subsidies from the Exchequer and methods of compulsory co-operation in marketing intended to secure remunerative prices for farmers. This was the policy which was in process of development in this country from 1930 to 1939. How far are either of these methods likely to be applicable in future?

Let us consider in the first place the possibility of a return to the policy of free trade in food—a policy that has many advocates on theoretical grounds, though the practical objections are generally recognized. One particular objection is to be found in the recent change in the rates of agricultural wages. In 1937, the average rate of wages for male agricultural labourers was about 33s. per week, covering in most counties a working period of 50 hours during the summer and 48 hours in winter. Overtime was paid either by an hourly rate or, in the case of cowmen and others who normally work longer hours, by an agreed higher wage. In 1940 Parliament provided for a national minimum wage, and the Central Agricultural Wages Board prescribed in the first instance a rate of 48s. per week. This sum was increased at the beginning of 1942 to 60s. per week for ordinary male labourers, with proportionate increases in overtime rates and in the wages of younger workers, women and girls. Taking it all round, the rise was about 80 per cent., and this meant that the total labour bill for the whole of England and Wales was increased to £90 millions, as compared with some £50 millions before the war. This sudden addition of £40 millions was paid for out of the increased receipts of farmers due to higher prices, which, under the impetus of the war, moved swiftly upwards. The index-number of agricultural prices (including Government subsidies), which in the three years 1937–39 was fairly steady at about 90½, jumped in 1940 to 125, in 1941 to 149½ and continued on the up-grade in 1942 (1927–29 = 100). The total value of the agricultural produce as calculated by the Ministry of Agriculture has not been published since 1939, when it was estimated at £220 millions for England and Wales, but it is obvious that with these higher prices it must have risen considerably, and at a rough guess probably amounted to £350 millions or more in 1941–42. The rise in wage rates has constituted, therefore, no serious burden on the farming community, but the position would be entirely different if after the termination of the war prices fell to anything like pre-war levels. Public opinion in this

country is not likely to consent to any material lowering of agricultural wages, and the fixation of wages really carries with it a corresponding obligation on the Government to regulate farm prices and farm receipts at a level which will enable the prescribed wages to be paid. This is not an argument which would be accepted by advocates of *laissez-faire*, but it is a statement of the position which has to be faced. It would be a tragedy if prices were allowed to slump while wages were maintained, so that agriculture was left to grope its way through slumped prices to some new peace-time economy.

The position which arose after the 1914 war is of interest in this connection, and affords an object lesson of what should not be allowed to happen again. In 1914, agricultural weekly earnings (including the value of some small allowances in kind) were estimated at 18s. per week. In 1917 a minimum wage of 25s. per week was established, and this was followed in 1918 by the appointment of an Agricultural Wages Board, which granted further increases by various stages rising to a maximum of 46s. 10d. in 1920-21. Afterwards the Board was abolished and wage-rates were left to be settled by "Conciliation Committees." In 1923 the rate under these bodies fell to 28s. In 1925 a new Wages Board was appointed and a different system adopted, the rates being fixed by County Committees. For a number of years the average rate was about 31s. 8d., though it fell to 30s. 6d. in 1933, after which there was some upward movement. Up to 1922 the changes in rates bore some relation—often a close relation—to the movement of agricultural prices, but from that date onwards prices tended downwards and wages, notwithstanding their low level compared with other industries, were high in proportion to the prices received by farmers. Thus in 1933 the index-number of agricultural prices (old series base 1911-13 = 100) stood at 107, as compared with 101 in 1914, whereas the average rate of wages was 30s. 6d., as against 18s. in 1914.

The lack of co-ordination between prices and wages was undoubtedly a pregnant source of trouble—though not the only one. It forced or encouraged farmers to economize at the expense of the workers by reduction of staff, and so led to unemployment and the drift to the towns.\* It stimulated the regrettable practice of standing men off in the winter months, when they were not needed for urgent work, and increased the tendency to neglect the general upkeep of the farms. It emphasized the inadequacy of prices and intensified the depression, though to some extent the increase in the wages level was counterbalanced by the reduction in the number of workers.

The unfortunate result of this lack of correlation between farmers' earning power and the compulsory cost of labour is worth bearing in mind, although perhaps there is no immediate danger of a reversion to the old system. This, however, was what was thought in 1920, when the Corn Production Act was quite unexpectedly repealed and agriculture found itself deprived of the assistance it had been led to expect. The view now generally held was expressed recently by Sir William Jowitt, in speaking on Planning † after the war, he remarked that "it was a matter of common sense and prudence, as well as for our own safety and well-being, that we should never allow agriculture to drift back to the position it had been in before the war." The problem is to discover how this can best be avoided.

\* The number of workers employed in June 1921 as returned to the Ministry of Agriculture was 869,000. In 1939 it was 607,000.

† House of Commons, December 1st, 1942.



The policy of leaving agriculture to find its own level in competition with other countries finally broke down in the financial crisis of 1931, and agriculture benefited to some extent under the general protective cover then introduced for the major home industries.\* A new policy was also inaugurated which it was hoped would secure the systematic organization of marketing, the regulation of supply and the development of those branches of farming likely to prove most remunerative. The great efforts made in this direction up to 1939 were only moderately successful, though it may well be that longer time was required to bring them to fruition. Basically the object throughout was to raise prices, though the measures adopted varied very widely as a result of the trade peculiarities of the different products and the consequent divergence in the means by which prices could be influenced. There was no uniformity, and in many ways it was an opportunist policy, aiming at satisfying the demands of the farming community without affecting too seriously the food supply or prices to the consumer. Four methods were employed either singly or in combination. There was first a tariff on imports; in the case of many imports this was of moderate dimensions, 10 per cent. *ad valorem* combined with Empire Preference being common at first, though much higher rates were imposed in the later stages. Secondly, subsidies were given to some products, particularly wheat, sugar-beet and fat cattle. The third method was the control of sale. Marketing Boards composed of representatives of producers and other interests were established and given power to regulate the marketing of some of the principal products and to fix prices; the primary object here was to restrict competition among farmers, and thus secure the benefits of co-operation by pooling prices. The fourth method and in some ways the most important was the quantitative restriction of imports so as to leave a greater share of the market to be provided by growers at home.

The tariff alone covered all imported agricultural products, and generally speaking this was the only assistance given to the less important products, including fruit and vegetables other than potatoes.

In the case of wheat, a subsidy was given in a form which deserves particular mention. A Wheat Commission was set up and a price of 45s. per quarter was fixed for a definite quantity, with a proviso that if that quantity was exceeded the price to all growers was reduced *pro rata*. Thus if the price fixed had the effect of encouraging production beyond a certain limit, it was automatically reduced. This extremely ingenious device attempted to meet one great difficulty in price-fixing, viz., that a price which gives some profit to a large number of producers may result in encouraging the inefficient or in encouraging the growing of the crop on unsuitable land, while at the same time it gives large and possibly undue profits to those favourably situated. Under the wheat subsidy system the price tended to fall if it resulted in the cultivation of an excessive area, and thus met to some extent this particular difficulty. It was, however, a method favoured by the special conditions of the wheat trade, and was difficult to apply to any other product. It had the effect of raising the wheat acreage in England and Wales from 1,197,000 acres in 1931 to an average of 1,750,000 acres in the three years 1937-39.

In the case of sugar-beet, the subsidy, which dates from 1925, was intended to induce the cultivation of a new crop, and is therefore on a quite different footing

\* I have not referred specifically in the following summary to Scotland and Northern Ireland, but the measures adopted in England and Wales were, generally speaking, applied to those countries with some local adjustments.

from the assistance given to agriculture in consequence of the depression. It was, moreover, paid to manufacturers, and was guaranteed for a 10-year period in order to give sufficient stability to the industry to induce the building of factories to deal with the crop. The scheme was so far successful that the acreage which before 1925 was quite unimportant rose to 396,000 acres in 1934. Afterwards there was some decline owing to the subsidy being limited to the produce of not more than 375,000 acres.

The other important product which was aided by subsidy was fat cattle, though this was combined with a restriction on the supply of imported meat, and the payments were dependent on compliance with a certain standard of quality. Some evidence of the success of the scheme is afforded by the fact that the total number of cattle in England and Wales increased from 6,358,000 in 1932 to 6,700,000 in 1937-38, though the influence of the milk scheme on this number must be borne in mind.

To meet the needs of pig-farmers yet another system was adopted, which, in addition to improving prices, aimed at expanding the production of bacon in this country. A Pigs Marketing Board was established which arranged contract prices between pig-producers and bacon-curers varying with the prices of feeding-stuffs. There was no subsidy, but the industry was assisted by a limitation of the quantity of bacon imported. A weakness in this scheme, however, was that it left the sale of pigs for pork quite uncontrolled, and at times when pork pigs appeared more profitable, farmers failed to observe their bacon contracts. The scheme did not prove very successful, and finally broke down at the end of 1936, though provisional arrangements were continued, and a new system was introduced in 1938-9.

A different kind of problem was met with in liquid milk. This was entirely home-produced, and foreign competition only existed in the form of condensed milk and milk products such as butter and cheese. Prices for many years had been more or less maintained by voluntary agreements between producers and buyers, but a collapse was threatened owing to differences between farmers favourably situated and those at a distance from the large markets. A Milk Marketing Board was set up which became the purchaser of all milk and the sole supplier of the retailers and distributors. There were many highly complicated features of the scheme, but in effect the receipts were pooled by regions, and producers received a uniform price subject to adjustments for special qualities and for transport. The policy adopted was much criticized, particularly from the consumers' side, but as an example of the national administration of a very perishable product it was in its way a triumph. It has been described as "one of the most remarkable achievements in the history of industrial organization." \*

The total sales of milk through the Board in England and Wales increased from 845 million gals. in 1933-34 to 1,063 million gals. in 1937-38—that is, by 25 per cent. The use of liquid milk for human consumption, however, remained more or less stationary, and the increasing surplus had to be used for conversion into cheese, condensed milk, etc. There was no general subsidy, but assistance was given to the Board in various ways, particularly to enable the supply of cheap milk to school-children.

One other crop to which reference may be made is potatoes. In former years a feature of the trade was the wide fluctuation in price as between one year and another, or indeed in the same season, as the consequence of a relatively small

\* *The Agricultural Register*, 1934-35.

increase or decrease in supply. The object before the Potato Marketing Board was to smooth out these fluctuations by regulating as far as possible the crops grown and the deliveries to market. Growers were limited to specified acreages, and the quantity of potatoes offered for sale was regulated by a limitation of size—that is, by withdrawing the smaller potatoes from market. There was no direct control of prices, but imports were restricted both quantitatively and by a duty.

The above is a brief description of the steps taken in the case of the principal commodities. Others which have not been mentioned are hops, barley and oats and sheep. Hops is a crop grown only in a few localities and on a limited acreage, and was the first product to have a Marketing Board. The Board has succeeded in keeping prices stable by arranging contract terms with brewers and limiting the acreage so that the demand and supply practically balance. There is a substantial duty on imports. Barley and oats were not assisted until 1938, when a subsidy on an acreage basis was introduced, the expenditure for this purpose in England and Wales being £2,070,000 in 1938-39. In the case of sheep, there was restriction of imports both live and dead, but no subsidy or Marketing Board. The question of assisting egg- and poultry-producers was much discussed, but no definite scheme was proposed till 1939.

The main object of the various arrangements described above was the raising of prices. The extent to which this object was attained may be judged by the Annual Index Number of Agricultural Prices 1930-39, given below. The most highly assisted commodity was wheat, and in the years when the normal price was low there was a very marked rise in the index-number (*cum* subsidy). In the case of cattle, the benefit derived from the subsidy alone was much less, and in the case of milk, where the assistance was small relative to the size of the industry, it was unimportant.

*Annual Index Number of the Prices of Agricultural Commodities*  
(1927-29 = 100)

	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Wheat ... ..	80	56	56	49	47	51	71	90	59	50
Wheat, including Government subsidy ...	—	—	74	94	89	85	91	96	94	98
Fat cattle ... ..	100	91	86	76	75	69	73	82	84	86
Fat cattle, including Government subsidy ...	—	—	—	—	78	80	83	92	95	97
Milk ... ..	95	82	84	84	88	85	85	94	100	98
Milk, including Government subsidy ...	—	—	—	—	89	88	87	95	102	102
Barley ... ..	80	80	71	83	86	80	86	109	84	105
Oats ... ..	68	68	74	61	69	71	70	92	79	79
Sheep ... ..	100	84	63	71	80	82	80	90	69	76
Pigs, baconers ...	104	74	63	70	77	70	78	83	84	87
Pigs, porkers ...	108	80	65	71	78	71	75	81	83	86
Potatoes ... ..	56	132	141	63	68	84	122	120	87	82
Hops ... ..	43	73	95	165	97	97	97	97	97	101
Sugar-beet ... ..	93	79	80	74	76	72	74	78	86	93
<i>General Index: All agricultural commodities (including Government subsidies) ...</i>	91	83½	81	77	78½	81	82½	90½	90	90½

The general index-number of all commodities shows that the lowest point was reached in 1933 at 77. Thereafter as the various schemes became operative there was a slow rise to 90½ in 1937, at which point the index was practically stationary for the next two years. This is not a very striking result when one considers the magnitude of the effort: the Acts of Parliament and the long list of Orders and Regulations, the very numerous Committees, Commissions, and Marketing Boards, the complications of the negotiations for the restriction of imports, the Treaties and International Agreements, and finally the fairly substantial Government expenditure involved. On the other hand, there can be little doubt that much was accomplished which was beneficial to the industry, particularly perhaps in the organization of sale and the equalization of prices, and that if the war had not intervened a basis was being laid for still wider developments. Moreover, the fact that there were already in existence Boards and Committees regulating more or less completely nearly every branch of the agricultural and horticultural industry must have been of enormous advantage in instituting war-time control.

How far could these methods be attempted again after the war? Obviously this depends on the conditions then existing, but it may be said that in the case of wheat and sugar-beet, which were aided purely by Government subsidies, there would in principle be no difficulty. It would merely be a question of the price to be offered and the size of the subsidy involved. If market prices were above the standard proposed, the advantage of the higher prices would accrue to the producer. In the case of milk and potatoes, both of which are in the main home-produced, any necessary increase in price could theoretically be passed on to the consumer or, alternatively, be met by a subsidy. Hops and sugar-beet also are matters of internal concern. It is different with products, such as live-stock and meat, the prices of which are dependent on the reduction of competition from abroad with the aim of giving the home producer a definite share of the market. Artificial restrictions of imports by tariffs, quotas and similar means involve interminable discussions with other countries and open up dangers of friction both internationally and with Empire countries which it is very desirable to avoid. The task of regulating prices by these means in post-war conditions would be enormous, and must probably be regarded as impracticable.

The object in view will, moreover, be quite different. In the years up to 1939 the purpose in the main was to raise prices; in the post-war years the purpose will be first to adjust to peace-time conditions the very disturbed and exceptional state of agriculture, with its concomitant high prices, and, secondly, to maintain prices at some level which will be satisfactory to the farming interest and prevent the recurrence of the difficulties which ensued after the last war.

In this connection there is a factor which is likely to result in an entirely different point of view from what prevailed in the years leading up to 1939. It is that the nation's ability to purchase goods from abroad will be much less. Our foreign investments have diminished, and it is possible that our indebtedness to other countries will have increased; there will be a greater need than formerly to pay for imports by corresponding exports, while the finding of remunerative markets for our exports is likely to be more difficult. No doubt there will be an enormous demand for goods for home consumption, but to supply this demand large imports of raw materials will be required as well as food-stuffs, and, whatever international agreements may be made, ultimately these goods will in the

main have to be paid for by exporting our own raw materials and manufactures. The figures involved are very large. In 1938, the value of the food, drink and tobacco imported was £431 millions, raw materials accounted for £247 millions, and manufactured articles for £234 millions, against which we only exported goods to the value of £532 millions. This is not a question to be discussed here, but if I am right in this broad view of the situation, State control either by Government purchasing or by licensing of imports or some similar means seems unavoidable. It cannot be left entirely to unregulated private enterprise to buy just what it likes with only exchange rates as a balancing factor.

The need for State control in this direction should make us cautious about attempting to abandon the present system of importation and distribution of food materials. A period of adjustment between war and peace will in any case be necessary, and if, instead of trying to get back as quickly as possible to pre-war conditions, a national control were recognized as both necessary and desirable, the problem of agriculture could perhaps be approached from a new point of view.

I am not sufficiently acquainted with the methods of war-time control to say how they could be applied in a peace-time economy, but it should not be impossible, with the knowledge and experience accumulated during the war, to adapt their best features in a scheme which, without too much interference with the buying needs of the public, would constitute a settled plan for the development of agriculture in this country.

One could, for example, imagine a system which would centralize the supply of the principal food products both from home and abroad and fix wholesale prices at rates sufficient to cover their average cost. So far as the home supply was concerned, prices could be settled not on prices based on the cost of foreign imports, but at rates sufficient to cover the average "cost of production." The products mainly concerned are wheat and other grains and meat of various kinds, which are all articles imported wholesale in large quantities and capable of being dealt with by organized methods. Products such as milk, potatoes, hops and sugar-beet only require internal organization analogous to that in force prior to the war. The regulation of food products, moreover, would not be a complete novelty even in peace-time. During the last decade, one commodity—milk—was completely controlled from the producer to the retailer, while schemes involving the control of imports and of the internal market were in force for various classes of meat, for potatoes and for other products.

In any case, the main object should be so to adjust the prices obtained for home produce that on the one hand excessive rates were avoided, and on the other that farmers felt some confidence in the future outcome of their production plans, and were thus encouraged to aim at a maximum output.

The precise method by which prices should be regulated would depend on the system of control adopted, but the schemes in force before the war are of interest in this connection. The wheat-subsidy plan was in principle a scheme for equalizing the cost of wheat, both imported and home-produced, by fixing first of all a price for home wheat assumed to be the average cost of production, and then levying through the millers the contribution necessary to make up the difference between this fixed price and the actual price as realized in the market. An important factor in the arrangement, however, was that the fixed price only applied to a standard quantity; if the production exceeded this quantity the price was automatically decreased. A safeguard was thus provided against any

abnormal increase in cultivation due to the price proving in practice unduly favourable. The results obtained in the early years of the experiment may be taken as an example. The standard price of 10s. per cwt. was applicable to a production of 27 million cwts., but in 1934-35 the output reached 36 million cwts., with the result that the average price worked out at 8s. 9d. per cwt. instead of 10s., and in the succeeding years there was a consequent tendency to reduce the area cultivated. Subsequently, in order to enlarge the output, it was considered desirable to increase the standard production to 36 million cwts., but the scheme showed the desirability of linking price and output so as to provide a means of testing the accuracy of the "cost of production" estimate. A natural check is in fact always provided—at least in normal times—by the fact that if the cultivation of a crop materially increases, it is evidence that the price is too high and that production is being stimulated at the expense of some other crop.

Most methods of price-fixing are based on estimates of average cost of production, and to some extent a difficulty arises here, because there is no scientific or satisfactory means of determining what is an "average" in the case of any particular crop. There is so much variation in conditions that a figure intended to give a profit to some growers may result in exceptional profits to others. An empirical solution by discussion with representatives of the growers, as in the case of the Marketing Boards, is probably the best that can be achieved at present, but there is always a tendency to arrange a price likely to be acceptable to the most numerous section of producers, and in this way to encourage cultivation by the less efficient or less favourably situated. This can be guarded against to some extent by looking not only at the price of each commodity separately, but by seeking also to preserve such a balance of prices as will induce the production of a certain supply, and, taking one price with another, will provide a reasonable return to the average producer. It is here that the idea incorporated in the wheat scheme of linking output with price should be of value. If an estimated area or output were specified for each principal crop or product with a standard price, it might be possible, with adjustments from time to time, to preserve such a balance of prices and production as would enable agriculture to supply a planned proportion of the country's needs.

A disadvantage in connection with the problem of fixing prices is the lack of adequate statistics. Our knowledge of the relationship between prices and costs of production is very indefinite, and whilst it is a platitude to say that farmers should receive "a reasonable remuneration" for their labours, there is no very obvious means of measuring this, nor is there any standard by which to decide what remuneration is "reasonable." An index of costs of production which admitted of comparison with the existing index of agricultural prices may be suggested as likely to prove a useful guide, and although it might not be possible to construct such an index for past years, a basis for the future might be built up by the annual publication of prices of the principal items entering into costs of production. Another statistical calculation which might be useful is an annual estimate of the gross cost of production comparable with the annual estimate of the value of the total output. In a recent paper,\* Mr. Kendall made a provisional estimate of this character which suggested some interesting conclusions, and if this were continued officially and based on more exhaustive

\* "The Financing of British Agriculture," M. G. Kendall, *Jour. Roy. Stat. Soc.*, Part II, 1941. See also "Some Observations in Regard to our Agricultural Statistics," R. J. Thompson, *Jour. Roy. Stat. Soc.*, Part I, 1942.

information, it would provide an indication of the average changes in costs of production and their relationship to prices.

Another source of statistical information could, I think, be found in the Income Tax Returns. Occupiers of farms assessed at £100 per annum and over are now liable to tax on actual profits under Schedule D, and if the returns so obtained, or a substantial sample of them, were analysed annually according to the size of the undertakings so as to show net earnings, we should have some reliable knowledge of the profitability of farming and of variations from year to year which is at present entirely lacking.

The assumption underlying the idea of regulating prices is, of course, that a settled policy in this respect would help to maintain and stimulate production. One of the major difficulties of agriculture has always been the uncertainty as to the price likely to be realized for a future crop. There may be an interval of twelve or eighteen months or more between the first and last stages of crop or live-stock production, and it has been impossible to foresee with any exactitude what prices would be realized when crops or live-stock came to be sold. This uncertainty added to the natural uncertainties inherent in farming due to the weather and other causes has been a formidable drag on enterprise. It has been well said that what agriculture needs is not high prices but stable prices, so that farm operations can be planned and organized on an intelligent basis. The regulation of prices is perhaps the most practical step that can be taken in this direction.

A special reason for evolving a policy which will favour the development of agriculture lies in the decrease in our power of purchasing abroad and the need for conserving our resources in this respect. The larger our home production, the less we shall need to import of those products which can be grown in this country, with the result that the saving thus effected can be utilized for the importation of raw materials and of additional food supplies. Before the war our home production was estimated to represent in terms of energy or calories about 40 per cent. of the total consumption, and in terms of value about one-half. These proportions have now been altered owing to our decreased dependence on imported feeding-stuffs and their partial replacement by home-grown crops. An important problem in the future will be the extent to which we can maintain this larger production so as to reduce the need for importation.

Another difference in the future position of agriculture is to be found in the question of rural planning. Practically all the space needed for building expansion has got to be taken from agricultural land of one sort or another, and this necessarily involves a reduction in our potential production. What the absorption of area in the future is likely to be is entirely uncertain, but in the 12 years before the war some 66,000 acres were withdrawn annually for building and other uses. If we assume that the rural development programme will involve something like four times as much, we get a loss of a quarter of a million acres annually, which, continued for, say, 6 years, would mean a total reduction of  $1\frac{1}{2}$  million acres. There is also the reduction which has taken place during the war by the utilization of land for camps, aerodromes, factories and service requirements generally. What this amounts to is not known, and some of it may ultimately be restored to agricultural use, but, taking the two together, a diminution in the agricultural area of  $2\frac{1}{2}$  million acres is not improbable, and it may easily be more. In 1939, there were some 24,600,000 acres under crops and grass and 5,600,000 acres classed as "rough grazings" (mostly mountain and

heath), so that a loss of 2½ million acres may easily represent a reduction of 10 per cent. in the agricultural output of England and Wales. It may, of course, be counterbalanced by more intensive cultivation, but it represents a substantial change in the agricultural position which should not be overlooked. The introduction of "planning" on one side of the fence seems to make a well-thought-out plan for agriculture more than ever desirable. Indeed, one of the basic assumptions of the Report on Land Utilization in Rural Areas was "the maintenance of a healthy and well-balanced agriculture," though the question how this was to be ensured was outside the scope of the Report. A satisfactory solution is fundamental not only to rural planning, but to other general schemes for the future of the country.

The suggestion which I have outlined to some extent in this paper is that a solution is to be found in a system of control involving the regulation of prices based in principle on average costs of production and calculated to give a moderate return to the producer. It is perhaps reasonable to suppose that the prospect of a fair livelihood based on a stable policy would inspire growers with confidence and lead to the land being cropped and utilized to its maximum extent. Prices on such a basis would not necessarily be higher on the average than the prices of corresponding imports, though they might easily be higher in some cases and lower in others. In any event, it may be argued that consumers in this country cannot reasonably expect that food prices should be below the cost of production. The question of the exact method by which such a system could be worked I have left unanswered, except to suggest that it involves State control—a control which is likely to be forced on us by the necessity for regulating importation in relation to our purchasing power—and that its basis might be found in the transformation of the best features of war-time control into a permanent system.

A consistent policy of this nature would carry with it an obligation on the farmer to make the best use of the land, and would demand efficiency in management at some moderate standard of scientific cultivation. This is an obvious counterpart to the advantages to be derived from a secure and permanent market: something more than the mere cultivation of the soil by rule-of-thumb methods would be required, otherwise the inefficient or indifferent farmer would merely be provided with the means of getting a livelihood on easy terms.

In addition to the farmer, the landlord would also benefit. During the past 40 years or more the depressions and fluctuating conditions of agriculture have had their repercussions on landlords in losses and abatements of rent and similar troubles. In return for increased security and permanence in future, a higher standard of up-keep and repair of farm-houses and buildings, and of the fencing, roads, draining and general layout of land could reasonably be required. This, in fact, is as necessary a part of the development of agriculture as proper cultivation and management.

The principle is the same both in the case of the cultivating farmer and of the landlord, and equally with the occupying owner. The State by a permanent policy would be giving substantial benefits: in return the farmer by his cultivation and management and the landlord by maintaining the permanent equipment of the farm at a high level would both be required to contribute their share to the national development of agriculture.

The results of a satisfactory agricultural policy would not be limited to the mere production of crops and live-stock. It would include the well-being and



prosperity of the country-side and would increase employment in many directions. The number of workers in agriculture has fallen of late years, but with a more progressive outlook in farming it might reasonably be expected to rise again, especially with the larger area under tillage for the production of food for live-stock. Expenditure on repairs and maintenance of farm buildings and equipment, moreover, is much needed. It is not possible to make any estimate of what it amounts to, but the carrying out of immediately necessary work would provide rural employment on a substantial scale. With a systematic policy there is a large opening for continuous work in this direction and in the improvement of the layout of farms generally. There is certainly scope for the use of very large quantities of fertilizers; the manufacture of these would provide employment quite apart from their use on the land; it is the same with machinery and implements and many other requirements. Prosperity in agriculture is not a question merely of farmers and the workers immediately dependent on them. Its influence extends to villages and country towns and to many industrial areas. I do not know that any calculation has ever been made of the number of persons directly and indirectly dependent on agriculture, horticulture and allied industries, but in total it must represent some substantial proportion of the population. The Report on Rural Planning estimated that the number of persons living outside towns was probably somewhere about 6 millions, of whom 2 to 2½ millions were in hamlets, farm-houses and isolated cottages, while there were probably 3½ to 4 millions in villages. For a large proportion of these the prosperity of agriculture is not a mere academic expression, it means something in their daily lives. In addition, there are those engaged in the manufacture of feeding-stuffs, fertilizers, machinery, etc., while a fair proportion of the inhabitants of country and market towns must also depend for their livelihood on trade ultimately originating in the land.

#### DISCUSSION ON MR. THOMPSON'S PAPER.

SIR WILLIAM DAMPIER: Mr. Thompson has dealt broadly with all the three people who are chiefly concerned in the land—namely, the labourer, the farmer, and the landowner, and, speaking generally, I am in accordance with what he says. If I pick out three points on which I should like further information, you will understand that I choose them merely to induce further discussion.

The author thinks that an improvement in the efficiency of farming should result in an increase in the number of labourers on the land. But I think it has to be remembered that any rise in efficiency, particularly in machinery, may mean an economy of labour and a lowered demand for men. I should like to ask Mr. Thompson whether he does not think that this is an important factor in the problem.

He rightly points out that there must be some concordance between prices and wages, and he says, broadly, that this has to be secured by some form of Government control. Then, just when he is promising to be very interesting indeed, he stops, and says that he is not going to tell us how it is to be done. I am sorry; I should like to have known.

The third partner in the agricultural industry is that unfortunate being, the landowner. Mr. Thompson thinks that he will be able to improve the equipment of the land. I should very much like to think that that is true, but we must not forget that the rise in the cost of repairs and improvements has been very large indeed. It may fall a little after the war, but I shall be surprised if it comes down to anything like pre-war levels. The difficulty of putting rents up

is, of course, extreme. Practically speaking, rent can be increased only when there is a change of tenant. I should like to hear from Mr. Thompson how he proposes to meet the difficulties of the owner.

But these are small points. Speaking generally, he has given us a very interesting paper, and I propose a most cordial vote of thanks.

MR. KINDALL: I second the vote of thanks with great pleasure, and am sure the Fellows present will join with me in saying how glad we are to see Mr. Thompson with us to-day.

His thesis, as I understand it, is that we must have an agriculture, and if necessary we must be prepared to pay for it; and then he goes on to consider how much we ought to pay. It might clear the ground for later discussion if I consider a question which arises at an anterior stage. If we are to have an agriculture, there are several sorts of agriculture we might have. Why do we want an agriculture at all?

It has to be remembered that we are primarily a commercial nation. We have risen to greatness through the medium of our commerce, and if we are to remain a first-class nation it must be through the medium of our commerce. To some extent, though not entirely, the interests of our overseas trade and of agriculture conflict, as we have found in the last twenty years, and to some extent they must continue to conflict. It is an overriding factor in the agricultural problem that if we are to proceed on the assumption that we wish to remain a first-class power, our trade must come first and our agriculture second.

When we come to consider why we want an agriculture there is one reason which is present in all our minds at the moment, and that is the matter of defence. We should have been in a very bad position if we had had no home production of food in this country, and it is encouraging to find that our agriculture, in spite of the difficulties it has experienced during the last fifteen or twenty years, has proved itself equal to the burden which has been laid upon it. Perhaps it is a pity that during one war we should, in our post-war planning, have regard to the prospects of another; but we must be realists in this matter. It would be absolute madness for any Government to demobilize its agriculture after this war, as it did its productive and its fighting forces after the last. From any realistic point of view we must accept the contention that agriculture must be maintained in some sort after the war, purely on grounds of defence. That does not mean that it must be maintained at the high pitch of production in which it exists at the present time. Obviously we cannot afford to keep it in the intensive stage in which it has been during the war, but we must at least maintain it in a condition under which it can be turned over at comparatively short notice to a high pitch of production, and that means not only keeping the land in a suitable state of fertility but maintaining in existence a sufficient body of farming skill in order to carry out that production.

When we come to consider the economic arguments in favour of agriculture we are on more contentious ground. There seem to be three. The first is based on the desirability of providing rural employment to which Mr. Thompson has referred. The argument is that we have a very old industry employing directly about one million people, and probably giving subsistence and indirect employment to two or three times that number, and that it would be a social and economic disadvantage to disband that industry. It seems to me that the argument is fallacious. It is not necessarily a social advantage to maintain an industry merely for the purpose of giving employment. Looking at it from the broadest point of view, the object of human endeavour is not to make people work, but to free them from the necessity of having to work, especially manual work such as mainly characterizes agriculture. If we are to employ the manhood of this country to the optimum, it might very well be to our advantage to encourage the flow of manpower from agriculture to industry. Nobody would suggest that we should permit agriculture to decline altogether, but—and this is where I link up with Sir William Dampier—it might definitely be an advantage to take men from the land, provided always, of course, that we can maintain production.

The object of agricultural policy, it seems to me, ought not to be to employ people, but to employ means of production, and if by using tractors and fertilizers and so forth we can avoid having so many men on the land, let us avoid it by all means.

The second argument is one of health. It seems to be believed that it is healthy to live in the country. I think that belief is founded on the undoubted fact that the death-rate is lower in rural than in urban areas. That is generally attributed to the effect of fresh air, but it is not by any means certain that that is the reason, and in any case, death-rate is not necessarily a true index of health. There are so many complications in this matter, so many transfers from town to country and from country to town, that this differential effect may be illusory. Some member of the Society might do a useful service by examining this question fully from the statistical point of view.

Overriding the whole question is the distinction between *living* in the country and *working* in the country. Many people say what an excellent thing it is to live in the country, but an agricultural labourer or a stockman who has to work from dawn to dusk, often under very bad weather conditions, would probably take a different view. I have heard it said, for example, that the percentage of Army rejects is higher among the rural population than among the urban.

Apart from the question of physical health, there is also the question of mental health. Anybody who has ever done a full day's work in the garden knows that, if he has leisure in the evening, he has no inclination for mental work, and the same thing probably applies to continuous as well as to occasional physical labour. If we are to emancipate the human spirit at all from the necessity for labour, we must give the agricultural labourer time to think as well as to act.

There is a great deal of false sentimentality surrounding this subject which we, as a body concerned primarily with facts and not with beliefs, ought to dissipate. That brings me to what I may call the philosophy of the "deserted village" school of thought. The problem of agricultural depopulation has been worrying people for two thousand years, since the time of the first Roman Emperor. But it did not become a serious problem in England until the eighteenth and nineteenth centuries, and then it was crystallized—embalmed would be the better word—in the work which is familiar to all of us from our schooldays by that model of frugality, sobriety, thrift and all the other agricultural virtues, Oliver Goldsmith.

Is there, in fact, any reason to deplore the flow of labour from the country to the town on social or economic grounds? That flow, presumably, takes place under ordinary economic laws under which the maximum national welfare will eventuate. In fact, the remedies which are proposed to destroy the movement are not so much the encouragement of rural life as the development of urban life in rural areas. It does not seem to me a valid argument in favour of preserving agriculture that we must preserve our rural population.

I regret that I have not time to go specifically into any of the interesting points raised in the paper. What I have said is really intended to clear the ground for the later part of the discussion.

The vote of thanks was then put from the Chair and carried unanimously.

LORD PERRY said that the paper was a very thoughtful one and covered a great deal of ground. With regard to the remarks of the last speaker, people were very apt to take it readily for granted that British agriculture was economically well worth while. During the last four years the "Dig for victory" campaign and the mobilization of waste land for providing food had grown to be a part of their lives. Personally his own view was that agriculture was very well worth while, but he had to grant that if he were an economist and looked at it only from that point of view he would be bound to confess that a given expenditure of man-power would produce more wealth in urban industry than when in agricultural work. Expenditure of £3 per week, which was now

the agricultural minimum wage, could show better results in the case of a man working in a factory than in the case of one working on the land.

While that was an economic factor to be considered, he did not think that the inference should be drawn that agriculture was not worth while. There was a good deal of virtue in "taking in our own washing," and he wondered whether the wealth which was produced in this country in manufacturing industry, if one drew up a balance sheet and remembered that when goods were sold abroad they were paid for by investments in foreign securities, the balance sheet would be as favourable as they supposed. He reminded the meeting of the bad debts that had been made on our foreign investments. Perhaps we should all be very much better off if we produced wealth at home and invested the money at home, primarily, of course, in agriculture. He did not believe in any sort of argument that it was imperative to have agriculture and home-grown food for the purposes of defence, although that might sound a foolish statement in view of what had happened to this country twice in twenty-five years. Our agriculture at home was dependent on the maintenance of sea power almost as fully as any part of our national existence. Sir William Dampier had called attention to the fact that in the mechanization of land the aggregate of labour to be expended on the land was in all probability reduced, but it was necessary to bring fuel for mechanization from overseas; fertilizers also came from overseas, as well as a great deal of such agricultural necessities as seeds.

He could quite imagine the Chancellor of the Exchequer telling him when he asked for the necessary money to support home agriculture that he could not get more out of a quart pot than it would hold, and that if he wanted control of the seas for his agriculture, which he certainly must have, he could not give him such control or find the money involved in maintaining such control, and at the same time give him—what the author had beautifully skirted over—the subsidies which British agriculture must have if it was to exist in a free-trade world market. It might sound a very wide and sweeping statement but we could not profitably grow in this country even radishes and lettuces, let alone our wheat and our meat, owing perhaps to the lower standards of living or the natural advantages or the better management existing in countries abroad. Those countries produced the foodstuffs on which we depended and produced them so cheaply that here we could not at present compete with them.

He liked the term "radishes and lettuces" because it came right down to their own back gardens. Even there they could not grow these market-garden products to compete with Holland, any more than they could grow wheat to compete with the Argentine or Canada or Australia. The National Farmers' Union, he believed, expected a continuation of what was started, most disastrously, in 1931 in the form of tariffs. God forbid that we should have any more subsidies! Food subsidies at the present time were costing us about 160 million pounds per annum, which was too big a burden to place upon the whole community for the maintenance of an industry employing 7 per cent. of our working population, which was all that agriculture represented.

But quite apart from that, when money was doled out by the Government it was so terribly wasted that it was bad economics to get any sort of subsidy from the Government. He himself ran some thousands of acres of co-operative farming. They started twelve years ago paying only what was then a 4 per cent. net annual interest on the money employed (it was now 5 per cent. gross, which was really 2½ per cent.) and dividing up all surplus earnings among the workers, the measure of their participation being according to the wages they earned.

When this scheme was started in 1930, working under the Friendly Societies Act, it was thought that they would be very fortunate if they could pay a sum equivalent to 25 per cent. more than the prevailing wage. That was what they aimed at. In the very first year, however, they earned more than that, and they made a rule afterwards that anything exceeding 30 per cent. was to be compulsorily saved, and quite a good aggregate of compulsory savings was accumulated. But when they came into the fortunate or unfortunate position—he was sorry to

say he believed it to be unfortunate—of receiving money from the Government in the form of subsidized prices, the amount of surplus available for distribution after paying a minimum basic wage of 64s. 6d. per week, and after taking into account depreciation and writing down of valuations so far as the tax authorities would allow, was in 1941 £50,000 for distribution amongst 200 men. Last year, 1942, it was £34,000. This represented a bonus on wages which varied from 250 per cent. in the horticultural department (that was intense cultivation) to 180 per cent. in the fruit area, down to 120 per cent. on wages in the lowest grade of all. Such profits were never earned, and were available only because the Government, into whose hands Mr. Thompson would like to commit the future of agricultural prosperity, paid such prices in their wisdom as produced these extraordinary and exorbitant profits. He felt that there was no future for a prosperous agriculture if it had to be subsidized by any such clumsy, unscientific, and ignorant methods. He was a firm believer in the future of British agriculture. He believed that it could survive if only they could restrain the unholy hands of Government from interfering. How that was to be done the author had not told them, and he would not tell them either.

MR. G. L. SCHWARTZ said that he could tell the last speaker at once why the radishes and lettuces could not be produced here. They could be grown here if workers could be obtained at ten shillings a week, and one could not get them because they were more valuably employed in other occupations. It would be an extremely disconcerting state of affairs if on this basis they could afford to grow some of these things here.

Mr. Kendall had said that this was a subject which was very dear to their hearts, but when it came to wishing his fellows well, his (the speaker's) benevolence extended itself to all mankind and to all industries and occupations. Not only did he wish to see the people in agriculture prosperous, but also the people who made soap, candles, nuts, rivets, bolts, linoleum, carpets, and everything else. All were occupations with just as much claim to assistance as agriculture, but the trouble was that if an attempt were made to give assistance all round, the economic system blew to pieces.

Any benefits artificially conferred, on agriculture or any other industry, simply tended to disappear in time, either by the incursion of new entrants into the occupation, bringing about a fall in prices and in remuneration, or, if the entrance of new people into the occupation were prevented, then a monopoly was created and the whole thing discounted itself in rent or in some other form of premium.

A year ago in that room he had quoted the case of a farm with a hop quota which was put up for sale. The hop quota was valued at £2,500, which simply meant that that premium had been conferred upon the then existing occupant. When the farm changed hands, the new holder had to pay that amount, so that he derived no benefit from the subsidy.

What was the basis for assistance? Mr. Thompson had referred to the term "reasonable remuneration" as a platitude, and economically it was a meaning less platitude and so were such terms as "maximum output," "reasonable prices," "satisfactory level of prices," the "average cost of production," and such high-sounding phrases as "a healthy and well-balanced agriculture." In practice they meant nothing, and when an attempt was made to translate them, they had to be taken right up to the Supreme Court, with the result that one got a healthy and well-balanced legal profession!

With regard to the situation of the country after the war, and the difficulties which might arise because of the reduction in our prosperity owing to the loss of investments overseas, it seemed to him that the conclusion to be based upon that fact was exactly the opposite to the one generally accepted. It was precisely in those circumstances that one would have to take care to get one's food from the cheapest sources possible.

Mr. Thompson had said that the policy of free trade in food had many advocates on theoretical grounds, though the practical objections were generally

realized. He was afraid the case was just the opposite. There were very few advocates of free trade in food on theoretical grounds. He himself happened to be one of them. As far as the practical objections were concerned, it was very difficult to state them and very easy to state the practical advantages. They could not have been better stated than by the Prime Minister in his last broadcast, when he said that this country had "grown great on cheap and abundant food." Had "it not been for the free trade policy of Victorian days her population would never have risen to the level of a great power, and we might have gone down the drain with many other minor States to the disaster of the whole world."

The present paper expatiated on the importance of a prosperous agriculture as a centre from which prosperity radiated to other sections of the population, not merely to the farmers and the workers immediately dependent on them. The same could always be said about any occupation. When he thought of the number of people who were producing books and paper and print, and remembered the people who were dependent on them he felt the same thing about the academic profession.

More nonsense was being talked now about the special place, function and significance of agriculture than at any other time in history. *The Times*, in connection with one of the agricultural schemes just before the war, said: "The Government's policy is designed to prevent a terrible intensification of the economic law by which the more there is of a commodity the cheaper it becomes." If manna fell from the skies a lot of people would be running round in circles saying: "This has got to stop. It is a national disaster."

MR. THOMAS DARLING said that the author had given an excellent and timely paper, and one which indicated to the Government the lines on which future agricultural policy should be based. It was absolutely imperative to have a prosperous agricultural industry in this country, at least for the next ten years, to cover the period of resettlement after the present war. He thought that some speakers in the discussion had shown a singular lack of appreciation of the very great effort which farmers and the agricultural community generally had made to keep the people of this country alive. Surely it was not necessary to argue before this Society that without agriculture this country could not live. It was now more or less generally admitted that the policy to be adopted immediately after the war was for the Ministry of Food to buy the output of the country and the imports from abroad and redistribute as at present. There were adequate safeguards against exploitation under the present conditions as farmers could not make excessive profits. Under the present system, with its effective safeguards, and with the greater experience which time would accumulate, he saw no difficulty whatever in creating such a state of affairs as would maintain a satisfactory agricultural industry in this country for a period of ten years.

In order to ensure that state of affairs as much accurate statistical information as possible was needed. He suggested that the farmers of this country should be separated for statistical purposes into two classes, those farming under, and above, 50 acres. The industry was quite differently organized above the 50-acre area from what it was below, the latter being small holdings with quite different problems of organization. He also pointed out that a wrong method was often adopted in requesting statistical information from farmers and others who were without the requisite knowledge. Many returns were inaccurate because a form appeared with upwards of one hundred questions on it, many of which did not apply to the particular case. The result was, they were liable to be very carelessly answered. Perhaps it did not matter very much—the inaccuracies might cancel one another out; but it was important to have these statistics as accurate as possible, and if some sort of expert clerical labour were available in different parts of the country, so that advice on these matters could be afforded to the farmer, it would be a great aid to statistical research. But that was perhaps too much to hope for at the present stage.

MR. G. S. BROWN said that the seconder of the vote of thanks had implied that our farmers were not able to compete with overseas food producers, and therefore were bound to have "pauperization" or subsidies. He thought it would be found that without such subsidy in pre-war years no other country sending stuff to the British market would have been able to compete at the existing price levels. From 1933 to 1935 the average retail price of fresh butter in this country was 1s. 2½d. per pound. There were about 22 countries supplying the British market at that time, and it was very significant that in every one of those countries the producers were subsidized to some extent. In Australia, for example, for ten years before the war every pound of butter had a subsidy of about threepence upon it. Consumers in Australia paid nearly twice as much for the same article as did the British consumer.

In 1938 the price of wheat per cwt. in the British market was about 3s. 8½d., almost the lowest point for forty years—but at that time there was a very definite subsidy to wheat producers in the United States and other exporting countries. If the United States, with its nearly thirty million people directly interested in the land, and with its reputation for mechanization and management methods, required a subsidy, the argument about relative efficiency of British and overseas producers rather fell to the ground. The subsidy which our wheat producers received in the form of deficiency payments was negligible as compared with the payments to the people who were sending goods to us. In most Empire countries they depreciated their currency in terms of the pound sterling, which gave them a bonus of 20 to 25 per cent. more. He still thought that the British producer, given access to adequate capital for equipment, which he had never had, could compete on equal terms with many of the overseas producers, except perhaps in such commodities as wheat, which was often produced abroad by "extensive"—though wasteful—methods.

Wheat and other cereals sent over to this market were sent simply because the British market was virtually the only free market at the time. Other importing countries had very much higher tariffs than we had. Exporting producers' actual costs in relation to world prices made it necessary for them to be subsidized in order to send it to our markets.

It had been said that agriculture could not compete with manufacture in respect of labour and general efficiency. That might seem to be true. But it was worth while to pay some attention to some facts as shown in the cost of living index. In 1937, and for several years before that, the retail cost of manufactured goods never fell below 70 per cent. above the level for 1914. The cost of food was only about 20 per cent. above the level of July 1914. Instead, therefore, of the community subsidizing the farmer, the farmer was subsidizing the community. It was only by the very low cost of food that the cost of living was made as low as it was. Most manufacturing industries lent themselves to a greater use of machinery and the development of new inventions, yet they were unable to compete with agriculture in relative cost of the finished produce.

MR. W. J. CUMBER said that he spoke as one whose only source of living had been from the land. He did not know until he arrived at that meeting that there were so many people in London who were not altogether sympathetic to the land industry. He had a good deal of sympathy with some of their arguments. Farmers had always been asking for something without quite knowing what it was they were asking for. He was one of those persons who, because of his ignorance, blamed the repeal of the Corn Production Act for the downfall of agriculture during the last twenty years. It had to be remembered that the percentage of corn grown in this country represented only 5 per cent. of the gross income of the farmer. In any reconstruction of agriculture he suggested that imports be considered as representing the variation between the cost of production in this country and the cost of production abroad. Wheat could not be produced in this country nearly as cheaply as it could be produced abroad. But

what was the good of subsidizing by a large margin one of the very products which overseas countries could produce so much more cheaply?

The following note was received after the meeting from MR. D. KENRICK:—

In the discussion on Mr. Thompson's paper, Lord Perry gave some very interesting information on the profits of the co-operative farm in which he takes such interest. He stated that they had risen to abnormally high levels under the Government's war-time price fixing, and from this premise he argued that Government control was bad. Surely the high profits are proof of the greater efficiency of his co-operative farm than that of other farms rather than a case against Government control of prices.

MR. R. J. THOMPSON expressed his thanks for the way in which his paper had been received, and said he would reply to the discussion in the Journal. He subsequently wrote as follows :—

Sir William Dampier is, of course, correct in saying that a rise in the efficiency of farming by the increased use of machinery results in economy of labour—in the area to which it is applied—but my suggestion was that as compared with pre-war days a larger number of workers would be required to maintain the higher level of production at which I think the country should aim—a level comparable in some respects with what is being achieved at present under war-time conditions. If, for instance, the area of arable land were permanently increased by say 50 per cent. from the 9 million acres of 1939 to 13 or 14 million acres and there were a more intensive production of meat, milk, etc., it is reasonable to expect that a greater labour force would be required, economics resulting from the use of machinery notwithstanding.

Sir William Dampier twists me gently because I did not produce a blue-print for the future of agriculture, but my main object was to draw attention to some aspects of the agricultural problem which seem to differentiate it from the past, and these involve questions which are sufficiently argumentative without going too much into ways and means.

On his third point, as to the ability of the landowner to improve or maintain the equipment of the land, various Lands Improvements Acts provide means for obtaining loans for permanent and semi-permanent improvements, and my view is that much greater use must be made of these facilities (or some extension of them) even to the extent of making repairs and improvements compulsory. No doubt there would be difficulties, but under a permanent policy for agriculture of the type I have suggested the landowner would benefit by increased security, and it would be a necessary corollary that there should be adequate expenditure on upkeep sufficient to ensure the proper development of the industry. To what extent improved equipment is needed is not known, but it is significant that in an investigation made in the Eastern Counties in 1937 into the condition of farm buildings on 227 farms, it was reported that on 41 per cent. of the farms the buildings were in poor repair, quite apart from a very large proportion which were regarded as inadequate or inconvenient. In fact, in that enquiry only 13 per cent. of the farms were found to be satisfactory in all these respects.

Mr. Kendall takes a more general view and discusses some of the reasons why we want an agriculture at all. In my view there is no separation in principle between trade and agriculture: they are both productive and both necessary. After the war there is likely to be a greater need than formerly to pay for imports by corresponding exports and the demand for imported goods and raw materials will be enormous. In order that we may obtain all the imports we require, we need to stimulate not only our export trade but also our agriculture so as to reduce our demands for imported food products and leave more of the balance between imports and exports available for the purchase of raw materials and goods which cannot be supplied from home sources. This, very briefly, is to my mind a fundamental reason for supporting agriculture—at least for some appreci-



able period until it is possible to take a fresh view of what the future has in store.

As regards another point mentioned by Mr. Kendall, I would not suggest maintaining agriculture merely as a means of providing employment. That is incidental. A prosperous agriculture is desirable on other grounds—one of the resultant advantages is that it provides employment and does so on a much larger scale than is usually recognized.

I rather disagree with Mr. Kendall in his comments on the desirability of a transfer of labour from agriculture to industry. By no means all the people born in rural areas can be absorbed in agriculture, but if it were possible to measure human happiness I should be inclined to think that country workers on the whole reach a higher standard than those in the towns. It may seem idealistic, but there is some evidence that under reasonable conditions men employed in agriculture take a greater interest in their work and experience a greater satisfaction in the performance of their changing tasks than do men in many industrial occupations.

In reply to Lord Perry, I would say that one cannot reasonably draw conclusions as to the effects of Government control from results obtained with minor crops, such as market-garden produce and fruit, at a time when supplies from Holland, Belgium, France and the Channel Islands were entirely cut off and there was consequently an entirely abnormal demand. My suggestions as to Government control related more especially to the more important commodities such as grain, meat, milk, etc.—commodities which, it must be remembered, were regulated to a greater or less extent for some years before the war.

Both Lord Perry and Mr. Schwartz object to any form of Government control and would leave agriculture to find its own level in competition with the agriculture of other countries, always with the underlying assumption that we can buy food more cheaply from abroad. It is by no means certain that this will always be the case. In the past great quantities of food have been exported to this country at prices which were certainly not remunerative to the growers, with the result that almost every country in the world in the years before the war was endeavouring to regulate its agricultural industry with the object of securing a better return to its own producers. The discussions at the United Nations Food Conference show that Government intervention is likely to continue. We cannot, in short, go back to the past. Control both here and in other countries must be accepted as inevitable. The problem is to discover the best and wisest way of applying it.

As a result of the ballot taken during the meeting the candidates named below were unanimously elected Fellows of the Society: -

Sydney John Endean-Rowe.	Stanislaw Kudlicki.
S. R. Kapoor, L.R.C.P., L.R.C.S.	L. Silberman, B.Sc.

*Corporate Representatives.*

Tadeusz Rózycki-Zamoyski.	} Representing The Polish Ministry of Finance.
Josef Aleksander Kronsten.	

## MISCELLANEA

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THE RELATIONSHIP BETWEEN EXPENDITURE PER HEAD AND SIZE OF POPULATION  
OF COUNTY BOROUGH IN ENGLAND AND WALES

By K. S. LOMAX, B.Sc., M.A. (Admin.)

1. Introduction.
2. Total Annual Expenditure per head on Rate Fund Services.
3. Individual Rate Fund Services.
4. Trading Services.

1. *Introduction*

AN interesting and most important question at the present time is: What is the most desirable size for a town?

One of the considerations affecting the problem is the relation between the size of a town and the cost of its public services. In comparing costs per head care has to be taken that local authorities are comparable in the services they administer. The only local authorities which are responsible for all the functions of local government in their respective areas are county boroughs.

2. *Total Annual Expenditure per Head on Rate Fund Services*

Suppose we divide the eighty-three county boroughs into the following groups according to the size of their populations.

- Group 1: less than 75,000
- Group 2: 75,000 to 100,000
- Group 3: 100,000 to 150,000
- Group 4: 150,000 to 300,000
- Group 5: greater than 300,000,

and work out the average total annual expenditure per head on Rate Fund Services for each group.\* The results for the seven years 1930-31 to 1936-37 are shown in the following table; 1936-37 being the last year for which the "Local Government Financial Statistics" have been published.

\* *Note.*—All figures relating to Expenditure per head and Rateable Value per head are expressed in £.

In all cases Annual Expenditure is Gross Annual Expenditure.

TABLE I  
*Annual Expenditure per Head on Rate Fund Services*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	7.74	7.80	7.83	8.05	8.35	8.55	8.78
Group 2 ...	7.64	7.75	7.80	7.98	8.21	8.31	8.43
Group 3 ...	7.43	7.54	7.70	7.83	8.12	8.23	8.52
Group 4 ...	8.01	8.08	8.12	8.25	8.69	8.81	8.94
Group 5 ...	9.27	9.46	9.53	9.65	10.17	10.32	10.49
Overall Average ...	8.24	8.36	8.44	8.58	8.98	9.11	9.29

The number of county boroughs and the average population in each group are shown in the following tables.

TABLE I(a)  
*Number of County Boroughs in Each Group of Table I*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	24	24	24	24	24	23	23
Group 2 ...	17	17	17	17	17	18	18
Group 3 ...	19	19	19	18	18	19	19
Group 4 ...	16	16	16	17	17	16	16
Group 5 ...	7	7	7	7	7	7	7
Total ...	83	83	83	83	83	83	83

TABLE I(b)  
*Average Population in Each Group*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	59,696	59,701	59,937	60,070	60,094	59,617	59,933
Group 2 ...	87,894	87,903	88,428	88,912	88,992	88,844	88,599
Group 3 ...	125,425	125,418	125,326	125,175	125,665	127,021	126,655
Group 4 ...	229,280	229,286	230,532	225,991	224,859	230,575	230,045
Group 5 ...	618,443	618,542	621,686	622,347	623,079	622,757	621,800
Total ...	160,332	160,343	161,003	161,501	161,461	161,835	161,602

It thus appears that neither the smallest nor the largest local authorities are the cheapest to govern, but that the optimum size is 100,000 to 150,000.

The question which immediately arises is: Is low expenditure per head associated with poverty?—that is, Are the costs per head of a local authority small because of necessity? If this were the case one would expect that groups 2 (75,000–100,000) and 3 (100,000–150,000) would have high density of population and/or low Rateable Value per head. The following tables show, however, that density of population is highest for the largest county boroughs and only in 1936–37 is minimum Rateable Value per head associated with minimum costs per head.

TABLE II  
*Density of Population      Population per Acre*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	10.8	10.8	10.6	10.5	10.4	10.2	9.7
Group 2 ...	14.5	14.5	14.2	14.1	13.5	13.2	13.2
Group 3 ...	18.4	18.4	18.0	17.4	16.2	16.1	16.0
Group 4 ...	19.6	19.6	19.0	18.4	18.4	17.5	17.4
Group 5 ...	20.8	20.8	20.7	20.4	19.9	19.6	19.6
Overall Average ...	17.5	17.5	17.1	16.8	16.4	16.0	15.8

TABLE III  
*Rateable Value per Head*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	6.18	6.24	6.29	6.36	6.61	6.77	6.91
Group 2 ...	6.09	6.14	6.18	6.28	6.50	6.63	6.77
Group 3 ...	6.28	6.40	6.49	6.56	6.90	7.08	7.23
Group 4 ...	6.36	6.40	6.43	6.50	6.77	6.93	7.03
Group 5 ...	6.67	6.74	6.79	6.85	7.15	7.23	7.31
Overall Average ...	6.40	6.47	6.52	6.59	6.87	7.00	7.11

In fact it is found that there is no significant correlation between annual expenditure per head on Rate Fund Services and either Density of Population or Rateable Value per head. On the figures for 1935-36 the coefficient of correlation between annual expenditure per head on Rate Fund Services and Rateable Value per head is 0.193, and is quite insignificant, while that between annual expenditure per head on Rate Fund Services and Density of Population is 0.118, and is again quite insignificant.

It thus appears that "poverty" is not the cause of low expenditure per head. Now, another explanation may be found in the different stages of development of the local authorities in the different groups. If the eighty-three county boroughs are grouped according to the degree of their expansion or decline in the period from 1930-31 to 1936-37, and the average annual expenditure per head on Rate Fund Services in each year calculated for each of the following groups:

- Group (i): -10% to -2%
- Group (ii): -2% to 0%
- Group (iii): 0% to +2%
- Group (iv): +2% to +6%
- Group (v): +6% to +20%

it is seen that each year annual expenditure per head on Rate Fund Services is at its lowest in group (iv).

The question then is: If the local authorities are grouped according to the size of their population, do those of these groups which show the lowest annual expenditure per head on Rate Fund Services do so because they contain a large number of the authorities which are expanding at between 2 and 6 per cent. per

TABLE IV  
Annual Expenditure per Head on Rate Fund Services

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group (i) ...	8-55	8-66	8-73	8-95	9-38	9-50	9-66
Group (ii) ...	8-42	8-54	8-64	8-81	9-36	9-78	10-10
Group (iii) ...	8-27	8-40	8-45	8-62	8-94	9-03	9-17
Group (iv) ...	7-63	7-82	7-91	7-97	8-35	8-31	8-47
Group (v) ...	8-35	8-29	8-38	8-43	8-65	8-59	8-68
Overall Average ...	8-24	8-36	8-44	8-58	8-98	9-11	9-29

seven years? In fact, however, the twenty local authorities which are expanding at the rate for which annual expenditure per head on Rate Fund Services is a minimum are distributed among the five population groups in a way which is not significantly different from distribution in proportion to the total frequencies in the groups. Furthermore, there is no significant correlation between annual expenditure per head on Rate Fund Services and the degree of expansion of the local authority from 1930-31 to 1936-37, the correlation coefficient, equal to 0.146, being quite insignificant.

Now, it may be that expenditure per head is low because the standard of service provided is poor. To investigate whether low expenditure per head on a particular service is associated with poor standard of service provided, the following table is drawn up for the year 1935-36.

TABLE V.

Population group	Libraries		Parks		Education		Maternity services	
	No. of vols. in lending library per head of population	Annual expenditure on public libraries per head	Acres of open spaces maintained by council per head	Annual expenditure on parks, etc., per head	Average no. of school children on registers per school	Annual expenditure on all education per head	Infant mortality rate	Annual expenditure on maternity, etc., per head
1	0-516	0-086	0-0042	0-201	232-7	2-30	59	0-101
2	0-643	0-091	0-0034	0-199	272-2	2-22	64	0-095
3	0-494	0-084	0-0037	0-238	258-4	2-23	65	0-085
4	0-538	0-093	0-0035	0-173	287-8	2-41	65	0-089
5	0-445	0-121	0-0037	0-177	298-0	2-42	68	0-125

Thus in three cases out of four minimum standard of service corresponds to maximum expenditure per head, and although there is a tendency for the group with minimum expenditure per head to be found towards the lower end of the standard of service scale, it is hard to find conclusive evidence for the association of expenditure per head in a population group with standard of service provided in that group.

There are, of course, other factors which may cause diversity in expenditure per head, but with regard to many of them—e.g., local peculiarities of site, soil, or climate mentioned in the introduction to "Rates and Rateable Values"—one would not expect that on balance they would be effective to such a degree

in a group of eighteen or nineteen county boroughs as to seriously affect the average expenditure per head for the group.

It does appear, then, that expenditure per head is a function, primarily, of population. This would imply that, in general, as long as the population of a local authority is not above approximately the 100,000 to 150,000 level, the economies of the large unit will operate to keep expenditure per head down, but that above that level the diseconomies will begin to counterbalance the economies and expenditure per head will rise as population increases.

### 3. Individual Rate Fund Services

The following tables show that, each year, the behaviour of annual expenditure per head on the most important individual Rate Fund Services is, generally speaking, very similar to that of total annual expenditure per head on all Rate Fund Services.

TABLE VI  
*Annual Expenditure per Head on EDUCATION*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ... ..	2.14	2.11	2.03	2.05	2.15	2.30	2.35
Group 2 ... ..	2.11	2.04	1.99	2.00	2.10	2.22	2.27
Group 3 ... ..	2.09	2.06	2.01	2.01	2.09	2.23	2.28
Group 4 ... ..	2.30	2.24	2.17	2.19	2.28	2.41	2.46
Group 5 ... ..	2.29	2.24	2.18	2.20	2.29	2.42	2.46
Overall Average ...	2.22	2.17	2.11	2.13	2.22	2.35	2.40

TABLE VII  
*Annual Expenditure per Head on POOR RELIEF*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ... ..	0.99	1.02	1.07	1.13	1.21	1.29	1.30
Group 2 ... ..	0.89	0.89	0.97	1.02	1.08	1.12	1.13
Group 3 ... ..	1.03	1.06	1.13	1.16	1.21	1.27	1.27
Group 4 ... ..	1.14	1.16	1.25	1.31	1.40	1.40	1.40
Group 5 ... ..	1.23	1.32	1.45	1.53	1.68	1.77	1.75
Overall Average ...	1.11	1.15	1.24	1.30	1.40	1.45	1.45

TABLE VIII  
*Annual Expenditure per Head on PUBLIC HEALTH*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ... ..	1.18	1.20	1.20	1.25	1.30	1.32	1.39
Group 2 ... ..	1.31	1.34	1.34	1.38	1.41	1.46	1.49
Group 3 ... ..	1.20	1.24	1.26	1.31	1.36	1.38	1.48
Group 4 ... ..	1.31	1.36	1.35	1.41	1.48	1.61	1.66
Group 5 ... ..	1.59	1.60	1.60	1.63	1.66	1.81	1.86
Overall Average ...	1.37	1.40	1.40	1.44	1.49	1.59	1.65

TABLE IX

*Annual Expenditure per Head on HOUSING*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	0.98	1.02	1.09	1.11	1.16	1.02	1.06
Group 2 ...	0.96	1.08	1.12	1.14	1.17	0.99	1.00
Group 3 ...	0.85	0.88	0.94	0.98	1.03	0.89	0.92
Group 4 ...	0.86	0.93	0.97	0.98	1.02	0.89	0.88
Group 5 ...	1.31	1.43	1.45	1.51	1.56	1.32	1.35
Overall Average ...	1.03	1.11	1.15	1.18	1.23	1.05	1.07

TABLE X

*Annual Expenditure per Head on HIGHWAYS*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	0.83	0.83	0.80	0.81	0.81	0.85	0.81
Group 2 ...	0.84	0.84	0.81	0.83	0.82	0.85	0.84
Group 3 ...	0.70	0.73	0.72	0.74	0.76	0.75	0.78
Group 4 ...	0.88	0.85	0.83	0.80	0.82	0.84	0.82
Group 5 ...	0.88	0.87	0.88	0.85	0.91	0.90	0.89
Overall Average ...	0.84	0.83	0.82	0.81	0.84	0.85	0.84

Minimum annual expenditure per head on any individual Rate Fund Service is thus usually to be found either at the 75,000 to 100,000 or the 100,000 to 150,000 population level.

There is actually very little difference between the behaviour of different Rate Fund Services, even between those services which are purely local, such as Education, Highways and some Public Health services, and those which are really national but administered locally, such as Poor Relief and Housing.

#### 4. Trading Services

Although the individual Rate Fund Services are very consistent in their behaviour, the tables which follow show that the different principal Trading Services exhibit different trends. With regard to Table XII, it should be pointed out that only forty county boroughs have financial transactions in respect of Gas Supply (in 1935-36 and 1936-37 the number falls to thirty-nine), and on examining the figures for the individual county boroughs, it is seen that Southend and Hull in each of the years 1930-31 to 1934-35 and Southend in 1935-36 and 1936-37 have infinitesimally small values, and they pull the averages for their respective groups well down; the two county boroughs Southend and Hull are consequently omitted from the analysis of annual expenditure per head on Gas Supply. In the case of each of the three other Trading Services no local authority which has financial transactions in respect of that particular service is omitted from the analysis.

TABLE XI  
*Annual Expenditure per Head on WATER SUPPLY*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	0.78	0.78	0.77	0.78	0.79	0.82	0.88
Group 2 ...	0.76	0.79	0.79	0.82	0.85	0.83	0.84
Group 3 ...	0.88	0.90	0.89	0.81	0.81	0.84	0.85
Group 4 ...	0.88	0.86	0.84	0.89	0.91	0.88	0.89
Group 5 ...	0.84	0.84	0.86	0.86	0.88	0.91	0.92
Overall Average ...	0.84	0.84	0.84	0.85	0.87	0.87	0.89

TABLE XI(a)  
*Number of County Boroughs in Each Group of Table XI*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	17	17	17	17	17	16	15
Group 2 ...	11	11	11	11	11	12	12
Group 3 ...	12	12	12	12	12	13	13
Group 4 ...	11	11	11	12	12	11	11
Group 5 ...	6	6	6	6	6	6	6
Total ...	57	57	57	58	58	58	57

TABLE XII  
*Annual Expenditure per Head on GAS SUPPLY*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	1.52	1.49	1.48	1.49	1.48	1.61	1.67
Group 2 ...	1.74	1.72	1.69	1.70	1.68	1.73	1.79
Group 3 ...	1.72	1.73	1.70	1.67	1.63	1.67	1.76
Group 4 ...	1.71	1.63	1.58	1.59	1.61	1.59	1.64
Group 5 ...	1.86	1.81	1.76	1.81	1.78	1.81	1.90
Overall Average ...	1.75	1.71	1.67	1.68	1.67	1.70	1.77

TABLE XII(a)  
*Number of County Boroughs in Each Group of Table XII*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	9	9	9	9	9	8	8
Group 2 ...	9	9	9	9	9	10	10
Group 3 ...	9	9	9	8	8	9	9
Group 4 ...	8	8	8	9	9	8	8
Group 5 ...	3	3	3	3	3	3	3
Total ...	38	38	38	38	38	38	38



TABLE XIII

*Annual Expenditure per Head on ELECTRICITY SUPPLY*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	1.61	1.73	1.77	1.88	2.03	2.21	2.36
Group 2 ...	1.69	1.72	1.77	1.78	1.97	2.05	2.23
Group 3 ...	1.60	1.72	1.78	1.90	2.05	2.23	2.46
Group 4 ...	1.36	1.40	1.51	1.60	1.75	1.73	1.91
Group 5 ...	1.77	1.82	1.88	1.94	2.12	2.24	2.43
Overall Average ...	1.60	1.67	1.74	1.82	1.98	2.07	2.26

TABLE XIII(a)

*Number of County Boroughs in Each Group of Table XIII*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	23	23	23	23	23	22	22
Group 2 ...	12	13	13	14	14	15	15
Group 3 ...	17	17	17	16	16	17	17
Group 4 ...	15	15	15	16	16	16	16
Group 5 ...	7	7	7	7	7	7	7
Total ...	74	75	75	76	76	77	77

TABLE XIV

*Annual Expenditure per Head on TRANSPORT SERVICES*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	0.92	0.93	0.95	0.93	0.96	0.97	0.93
Group 2 ...	1.39	1.41	1.38	1.26	1.25	1.19	1.21
Group 3 ...	1.49	1.52	1.47	1.40	1.43	1.47	1.50
Group 4 ...	1.59	1.56	1.51	1.40	1.39	1.52	1.57
Group 5 ...	2.10	2.11	2.00	2.03	2.06	2.13	2.21
Overall Average ...	1.66	1.66	1.60	1.55	1.56	1.63	1.67

TABLE XIV(a)

*Number of County Boroughs in Each Group of Table XIV*

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Group 1 ...	18	18	18	18	18	17	17
Group 2 ...	15	15	15	15	15	16	16
Group 3 ...	17	17	17	16	16	17	17
Group 4 ...	15	15	15	16	16	14	14
Group 5 ...	6	6	6	6	6	6	6
Total ...	71	71	71	71	71	70	70

Close investigation of the figures of annual expenditure per head on Trading Services would involve technical considerations; for example, in the case of Electricity Supply, account would have to be taken of the development of the "grid." These technical factors are probably one of the reasons why expenditure per head behaves so differently for different Trading Services; it is, for example, unlikely that the optimum unit for the operation of an Electricity Supply undertaking is the same as that for the operation of Transport Services.

The Trading Services are, however, consistent with the Rate Fund Services in that, with very few exceptions, the largest county boroughs—that is, those whose populations exceed 300,000—are the most costly to govern. The smoothest and most notable trend relating annual expenditure per head with population for a Trading Service is that for Transport Services—a continuous and smooth tendency for annual expenditure per head to rise as population increases.

## VOLUME OF INDUSTRIAL PRODUCTION

By H. LEAK, C.B.E.

IN *Studies in the National Income, 1921-38*, a section is devoted to the volume of production, and results are arrived at which are open to serious question. Unsound methods have been employed, a number of errors appear in the figures and the Census of Production results are misrepresented. To deal with the last and least important point first, it is said, for example, that the basis of the volume of production calculation in Part V of the Final Report on the 1930 Census of Production is "net output of fourteen large industrial groups in 1924. . . . For the tables, pp. 147-150 below, however, a more elaborate method was adopted. Each of the 130 industries was taken separately. . . ." That was the Census method, it being stated specifically on page 42, "The results of applying the change in volume of production for each trade to the net output are shown in the following table for each group of trades." The methods being identical, the index-numbers for the fourteen groups of trades should be the same, but that for the Clothing group is given as 109 as against 111.5 in the Census report.

The table on page 138, given as an example of the method followed, shows for several trades (1) 1924 value as returned, (2) the same valued at 1930 prices, (3) 1930 gross output, (4) index of production, and (5) 1930 at 1924 values. The last column, it is said, "is deduced by a process which would be exact if there was only one uniform product. It may be noticed that the product of the numbers in the first and third columns equals that of those in the second and fourth" (*sic*). That the last column is not what it purports to be, since there is not one uniform product, may be made clear by an example taken from Dr. Rhodes' computations (London and Cambridge Economic Service Special Memorandum No. 47), of which considerable use is made in this chapter. Dr. Rhodes worked out an index for the cutlery trade based on the three items, knives, complete safety razors and razor-blades, and found an index of production in 1935 compared with 1930 of 231.7 when output was valued at 1930 prices and of 165.9, when the valuation was at 1935 prices. The value of the output in 1935 at 1930 prices was £5,538,000, using Dr. Rhodes' correct method of revaluing the three items. The corresponding figure arrived at by the method adopted in this book is £3,960,000! This is rather an extreme case, and the difference over the whole field would be much smaller, but marked changes did take place between 1930 and 1935 in relative prices of commodities and in relative quantities of the different descriptions of goods produced (resulting partly from the tariff) and the short-cut method used in the book is definitely faulty.

In Part V of the 1930 Census report index-numbers are given of the volume of production in each trade—*i.e.*, taking into account the whole of the output of the firms assigned to the trade. In the other volumes and in the corresponding 1935 volumes, index-numbers are given of the volume of production of the principal products of each trade, irrespective of whether these were produced by firms in the trade or not. These may differ very considerably—the output of tools and implements, for example, was 1 per cent. higher in 1930 than in 1924, but the output of firms making returns on schedules for the tool and

implement trade fell by 19 per cent. Though the difference between these two calculations is made clear in the Census of Production reports, the volume of production is calculated in this book by applying to the gross or net output of the firms in the trade the volume of production of the principal products of the trade. Over all, the errors may cancel out to a considerable extent, but the volume of production calculated in this way for individual trades or groups of trades may go far astray.

As already mentioned, considerable use has been made of Dr. Rhodes' results. His method was to use the principal quantity figures available for any trade as indicative of the change in total output, neglecting not only the output recorded by value only but the minor items recorded by quantity, *e.g.*, account was not taken of the output of scissors or of ordinary razors in the cutlery trade, though these were recorded by quantity in both years, *i.e.*, the coverage was not so good as it could have been, and it was, in fact, very low for some trades. For certain trades, *e.g.*, shipbuilding, hardware, furniture, tailoring, etc., however, he did not find any data that he could use. In such cases the output in the trade was assumed to have the same quantitative change as that of the other trades in the group. His treatment of the missing output was thus consistent, but it led to surprising results. The volume of output of shipbuilding was assumed, for example, to have risen by over 50 per cent. between 1930 and 1935 (using 1930 prices), but whereas the net output of the other trades in the group rose from £202 million to £225 million, that of shipbuilding fell from £27.6 million to £15.2 million. The method of assuming the same quantitative change is clearly defective, and it would have been much better to assume the same price change for the missing output as for the output recorded by quantity, as was done by Mr. Devons (*The Manchester School of Economic and Social Studies*, Volume X). More elaborate methods are adopted in many cases in revaluing missing output in the Census of Production estimates, but the price change of closely associated items is frequently used.

The addition of the volume index-numbers by any method other than by net output is not justified. If a high-valued product is worked upon, as for example in gold-refining, it has a disproportionate influence on the total, and equally coal-mining would be given too small a weight. But this book gives index-numbers for groups of trades and for the whole industrial output arrived at by weighting the volume index-numbers for individual trades by gross output as well as by net output. It may, however, be significant, as indicating the author's doubts on the validity of weighting by gross output, that although the figures for the various groups of trades and the total are given in a table, the index for the leather trades as a whole is not included in the table for those trades given in the text. The two methods of weighting are used to arrive at the change in average value of the raw materials used between the censal years. All the deficiencies in the figures are accumulated in these index-numbers. The fall of 18 per cent. found between 1924 and 1930 is compared with the fall in prices of materials recorded in the Board of Trade and *Statist* index-numbers of wholesale prices, and the conclusion is reached that the figures in this period are only consistent if materials were purchased many months before the goods were sold. (The table given shows average prices in the second half of 1929 as 21 or 22 per cent. below 1924.) It is defective for two reasons: (1) only industrial materials and manufactures are taken, whereas a great part of the food and tobacco included in the wholesale prices index-number is processed

in this country, and (2) if there is a period of many months between the purchase of materials and the sale of the goods (and there certainly is a considerable period, though not so long as the author suggests), this would apply in 1924 as well as in 1930, and index-numbers for 1923, when prices were rising, should also have been given. The author expresses satisfaction that there is very close agreement between the fall of 10 per cent. found in prices of materials between 1930 and 1935 and the fall in wholesale prices between 1930 and either 1934 or 1935, but this agreement is destroyed by the comparison already made between 1924 and 1930.

In order to see how the method of estimating price changes in materials would work out for three trades in respect of which practically the whole of the materials as well as the gross output are recorded by quantity and the products are relatively few, I have had calculations made comparing the years 1935 and 1937, for which there is the most complete information about materials purchased and used. For one of the trades the formula gives a price change over 1 per cent. different from that calculated direct, notwithstanding that the two years are so close together. An offsetting change in another trade makes the aggregate price rise for the three trades identical by either method. This is not a complete or even a representative test\*, since the quantitative relationship between materials and output is close—in cases where considerable variation may occur from year to year in the description of goods made from the same materials greater diversity in index-numbers calculated by the formula and calculated direct may be expected. If, as is continually happening, the same quantity of materials is being used to produce a greater volume of goods, this would cause the price index for materials calculated by the formula to differ from the price index calculated direct.

*Price Index for Materials Purchased and Used, weighted by 1937 quantities*

1935 = 100

Trade	Computed by direct evaluation	Computed by formula
Blast Furnaces ... ..	136.0	134.2
Tinplate ... ..	124.3	124.2
Cotton Spinning ... ..	106.7	107.4
TOTAL ... ..	115.6	115.7

The tables on pages 176 and 177 relating to the small firms contain a number of figures which differ, for some unexplained reason, from the published Census figures. The number employed in the tailoring, dressmaking, etc., trade in 1924 is given as 123,000, against 112,000, leading to an over-estimate of the total for that year by 10,000. The number employed in the small mines and quarries is stated as 10,000 in both 1924 and 1930, the Census report giving 7,000 and 13,000 respectively. The number shown as employed in the building and contracting trade in 1930 differs by 4,000 from the official estimate, but the difficulty of making an estimate in this trade is greater than in any other, owing

\* Lack of time for the necessary arithmetic has prevented my extending this test, as I should have wished to do had circumstances been normal.

to the large number of firms from which no returns were received; but one would have expected the figures to agree, since they agree precisely for 1924, when the difficulties of estimation were much greater. The net output of the small firms in the motor and cycle trade in 1930 is given as £7 million, compared with £6 million in 1924 and £10 million in 1935. Since employment was 33,000 in 1924 and 63,000 in the two later years, the official estimate of £10 million for 1930 is the more probable. In the chain, nail, screw, etc., trade, the net output of the small firms is shown as having risen from £2 million in 1924 to £3 million in 1930, the reverse of the official estimates. The latter must be the more accurate, since the small firms were almost entirely engaged in blacksmithing and the numbers employed fell between 1924 and 1930. Other cases could be quoted, but sufficient has been said to warn the reader not to accept at face value the figures in this section of the book.

In studies such as this, sponsored by the National Institute of Economic and Social Research, one expects a high standard of accuracy, both in methods and in figures, and it is rather distressing to have to call attention to the lack of accuracy in this particular study. I am very glad to see the Census of Production figures made use of, but would venture to suggest that those who intend to *publish* any analysis of the figures would do well to afford those responsible for the figures, which are not easy of interpretation, an opportunity of comment before publication. It is particularly important in this instance, since estimates of the volume of production for 1935 have been made by the use of inadequate methods applied to the incomplete data published in the preliminary report on the 1935 Census, whereas the full data and the detailed volume index-numbers for principal products in all trades were available in the Board of Trade when this section of the book was being prepared and the corrected galley proofs of Part IV had been placed in the library of the Royal Statistical Society before the introduction to the book was written.

THE INDUSTRIAL APPLICATIONS GROUP OF THE ROYAL STATISTICAL  
SOCIETY: FIRST SESSION, 1942-43

By BERNARD P. DUDDING, Deputy Chairman of the Organizing  
Committee

WHEN the Industrial and Agricultural Research Section (I.A.R.S.) of the Royal Statistical Society was founded in 1933, one of the aims was to encourage the use of statistical methods in the manufacturing industries, but the relative backwardness of the development in these industries compared with the position in agriculture tended to restrain the workers in the former from joining as freely in the activities of the Section as many of those interested in this work had hoped.

The disorganization of normal activities caused by the war, whilst severely handicapping the work of the Research Section, had the effect of greatly stimulating the interest of Engineers in the use of statistical methods. This interest was aroused by reports made by members of a British mission to the United States of the utilization of the methods for aiding efficient production and inspection in the ordnance factories there. The relatively few Fellows of the Royal Statistical Society who had experience in the manufacturing industries soon found themselves actively engaged in addressing formal and informal gatherings of engineers arranged by one or more of the Engineering Institutions.

The writer of these notes felt there was a real danger that the relatively simple application of statistical principles concerned might become somewhat divorced from the main field of statistics, and that narrow specialized groups might be organized by the engineering bodies. Following preliminary discussions, a letter was sent to Professor Pearson, Chairman of the Research Section, over the signatures of Mr. W. J. Jennett, Mr. L. H. C. Tippett, Mr. H. Rissik, Dr. B. L. Welch and the writer, asking him to transmit to the Council of the Society the suggestion that some of the activities of the Section should be revived so as to provide opportunities for discussion by engineers of the application of the methods to industrial problems, under the guidance of statisticians and the auspices of the Royal Statistical Society.

The pioneer work required was of such a nature that papers dealing with new developments were not desirable, but rather there was a need for meetings designed to help engineers to learn how known principles could be used to give them valuable aid in their work. Following the terminology which has found general acceptance in the United States, "Quality Control" has come to be associated with those methods based on mathematical statistics which find ready application in the recording of data derived from patrol inspection carried out systematically at various points in the manufacturing procedure. One of the principal aims of Quality Control is to provide early information of any change in the manufacturing procedures, thus enabling corrective action to be taken to prevent the waste of labour and material involved in manufacturing articles a large proportion of which may subsequently be found to be useless or to need correction. In some cases it has also been possible to reduce greatly the amount of labour absorbed by inspection once Quality Control technique has become established. It was not expected, however, that the discussion meetings should confine themselves to the somewhat narrow scope of

Quality Control, but that extensions of the statistical method as an instrument of research should come under review.

Professor Pearson raised the matter with the Council who, at their meeting in October 1942, gave general approval to the proposals outlined in the letter referred to above. As a result the Industrial Applications Group was formed with the following as an Organizing Committee: Professor Pearson (Chairman), Mr. H. E. Daniels, Dr. B. P. Dudding (Deputy Chairman), Dr. Gooding, Mr. W. J. Jennett, Mr. H. Rissik, Mr. J. F. Stanley, Mr. L. H. C. Tippet, Dr. B. L. Welch and Mr. J. Womersley.

Following the experience of some members of the Committee in other fields of applied science the meetings were organized primarily to promote discussion, one or more persons being asked to prepare short statements illustrative of simple applications of statistical principles to data obtained from factory records. Four such meetings have been held under the chairmanship of the writer. They were held in the Lecture Room of the Lighting Service Bureau, 2 Savoy Hill, by kind permission of the Electric Lamp Manufacturers' Association. That the meetings have fulfilled their purpose is generally agreed, and a measure of the success achieved can be made by noting that several engineers travelled from West and North England on more than one occasion and some visitors came from Scotland. The average attendance was approximately 65, the lowest recorded being 49 and the highest 86.

The following is a brief summary of the proceedings at the meetings.

#### *First Meeting, December 18th, 1942*

*Subject* : "The relation between design tolerances and control-chart limits in manufacture."

This was introduced by Mr. H. Rissik and Mr. W. J. Jennett. The theme of the discussion was to emphasize that control-chart limits are derived from observed data and arise from the variability inherent in a manufacturing procedure, whilst design or specification tolerances are often imposed in order to meet operational or functional requirements. The latter usually apply to individuals, whilst the former are usually associated with the average of, or the range in, the observations made on a small sample containing a few individuals. It was clear that some engineers find a little difficulty in appreciating the practical import of this difference between two sets of numerical values. Messrs. Rissik and Jennett demonstrated how the design tolerances and control limits should be related if the manufacture was proceeding satisfactorily; that is, when the product substantially meets the requirements imposed by the design or specification tolerances. They also illustrated how, under certain conditions, control-chart limits can be set to enable full advantage to be taken of design tolerances. The views expressed during the discussion confirmed the wisdom of considering this subject.

The Chairman emphasized that in many cases opposition to the introduction of Quality Control can be greatly reduced, or even eliminated, by pointing out that the limits for the control chart are derived from what has been achieved by those concerned, and are not imposed by authority. With this approach, however, a clear conception of the relation between the limits and design tolerances is necessary if a correct technical interpretation of the charts is to be made. Contrarily, it is sometimes argued that statistical



relationships connecting spread and sample averages and variation in individual values should be used to calculate control-chart limits from design tolerances. It will be found, however, that besides lacking the appeal to the practical man indicated above, this procedure does not promote clear thinking, and will in most cases lead to greater confusion, in the minds of those closely concerned with production problems, than the former method, which usually appeals to them as a common-sense method of introducing a new tool for engineers. Since this meeting examples of mental confusion on this subject have been encountered, and it is obvious that further similar discussions should be arranged for groups of engineers newly interested in the subject.

*Second Meeting, February 19th, 1943*

*Subject:* "The study of Qualitative data—material classified as defective." The discussion was introduced by Mr. Worley.

The particular type of problem on which attention was focused on this occasion is that often encountered when the requirement is functional and the test applied expensive and/or destructive. Under these conditions the size of the sample is necessarily small, and if the quality of the product is reasonably satisfactory on technical and economic grounds, the occurrence of a defective or non-functional article in a sample is rare. What is desired is a method which will indicate

(a) whether the proportion of " defectives " in the product is reasonably constant;

(b) what is the proportion of " defectives " in the bulk product.

The method described by Mr. Worley depended on examination of samples drawn from successive batches of product having the same origin, and plotting the accumulated total number of " defectives " found, as ordinate, against the total number of samples tested. The central feature of Mr. Worley's contribution was the description of a simple adjustable tool made of celluloid, by the use of which both the average slope of the line through the plotted points (a measure of the proportion defective) and the position of the usual 19/20 and 499/500 limits for individual points could be readily determined, using any point on the curve as origin.

*Third Meeting, March 26th, 1943*

*Subject:* " Group Control Charts," introduced by Dr. Sealey.

The object of the paper was to illustrate a convenient method of handling data derived from multi-spindle machines, or to groups of machines employed in producing the same article from the same bulk raw material.

Samples containing a few articles are selected for measurement from each spindle, and instead of constructing charts for each spindle, charts are kept on which are plotted the highest and lowest average recorded in each group of samples (6 samples for a 6-spindle machine), and the greatest range found in the samples.

This paper evoked a particularly good discussion, especially from the viewpoint that in achieving some economy in recording, there is undoubtedly loss of information. It was explained that experience with the proposed method was limited, but the interest aroused will undoubtedly lead to further use of the method and comparison with those more generally accepted.

It is important to record that, at the conclusion of the meeting, the Chairman, at the request of the Committee, asked those present whether further meetings should be postponed until the autumn. The meeting was unanimous in requesting that a further meeting be arranged before the summer recess. A date in May was agreed upon and the decision was fully justified as the attendance was the largest recorded.

*Fourth Meeting, May 14th, 1943*

*Subject* : "Other applications of the Quality Control Chart Technique."

Four brief statements describing a variety of uses were made by Messrs. Tippet, Rissik, Jennett, and Womersley in that order.

Mr. Tippet reviewed broadly methods useful in the study of accumulative data when technical information is sought for, as distinct from the normal use of the control chart as a running commentary on the quality of a product.

Mr. Rissik concentrated on the use of the control chart to provide engineers with information which would normally be derived by statisticians by the use of the analysis of variance.

Mr. Jennett dealt with the inverse problem, and showed how the statistician, having used the analysis of variance to determine statistically significant differences amongst groups of technical data, could use the control chart to place the information before engineers in a form more readily appreciated by them.

Mr. Womersley called attention to the information which control charts give of the performance of the machines with which they are associated. The meeting readily appreciated how such charts not only provide data on the variability inherent in the performance of different types of machine, but also gave information as to the rate of deterioration in performance when called on to fulfil different duties.

This last meeting served a very useful purpose, and it is confidently expected that it will contribute in some measure towards providing subjects for the next session, which is planned to open on October 8th, 1943. It is also expected that a meeting will be arranged in the Manchester area in late September.

## REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—*Statistical Analysis in Biology*. By K. Mather. London: Methuen. 1943. 8 $\frac{1}{2}$ "  $\times$  5 $\frac{1}{2}$ ". 247 pp. 16s.

Though the scope of this book is similar to that of others recently published, Dr. Mather has had the courage to depart from tradition both in the order and in the form of his presentation. This is particularly noticeable in his refusal to admit that biologists are incapable of understanding the simplest of algebraic demonstrations. Many readers will at first be deterred by the amount of algebra; those who take the trouble to study it will not find it difficult and will undoubtedly gain considerable benefit from the resulting clearer understanding of elementary statistical processes. This advantage will not be confined to the biologist for whom the book is intended, as the mathematician should find in these occasional pieces of algebra familiar landmarks to guide him in his first approach to an unfamiliar branch of applied mathematics.

"Statistics," says Dr. Mather, "is the mathematics of experiment," indicating an intention to limit his discussion to the analysis of experiments; such a restriction is legitimate, though it is not desirable to give the impression that this is the whole field of statistical analysis. While the analysis of experimental results is undoubtedly an important part of modern statistics, most statisticians have frequently to give their attention to data which are not the products of controlled experiments, and which, for that reason, have their own peculiar difficulties. Even accepting this restriction to one aspect of statistics, it is surprising to find in this book no mention of the sampling of experimental material, and the use and reliability of estimates obtained from such sampling.

The main chapters on the analysis of variance and its ramifications are preceded by an excellent account of the inter-relations of the normal,  $t$ ,  $\chi^2$ , and  $z$  distributions, though this interesting section might be better deferred until the uses of the various distributions have been described. Dr. Mather's account of the analysis of variance itself is less satisfactory, as the facility with which his examples are presented may lead the unwary to believe that there is here a perfect guide for all such analyses. The suggestion that there is a limited number of ways of subdividing a sum of squares with several degrees of freedom into components with single degrees of freedom is an unfortunate, though probably unintentional, consequence of the listing of various symmetrical subdivisions for two, three, and four degrees of freedom.

The inadequacy of the discussion of the barley yield data will be readily appreciated by those familiar with the detailed treatment of the same data given elsewhere by F. Yates and W. G. Cochran, while reference to the original paper will show the apparently remarkably high yields to refer to bushels per three acres, not per acre. Another error, common to many text-books of statistics, occurs in an example of regression analysis applied to the uptake of rubidium and bromine from rubidium bromide by potato slices, the lack of independence of the two sets of observations being ignored in the comparison of two regression coefficients.

The sections on experimental design are a good elementary introduction to

the various problems, especially in relation to confounding. A useful chapter on polynomial and multiple regression contains also a section on discriminant functions, a method not yet commonly found in books on statistics, but one which may become increasingly important. The subjects of the two final chapters, frequency data and the method of maximum likelihood, are those on which Dr. Mather's experience best qualifies him to write, and the discussion given is better and more complete than is usual in a book of this nature. The biologist who takes the trouble to study these chapters carefully, especially those portions concerned with the theory of estimation as developed by R. A. Fisher, should derive considerable benefit. In view of the difficulty found by many people in appreciating the precise meaning of a statement of fiducial probability, it would be desirable in future editions of this book to amplify the paragraphs dealing with this subject and to remove the grounds of possible misinterpretation.

The book ends with a glossary of statistical terminology and a short series of tables. The shortening of tabulated values so as in general to show only two digits should encourage the user to make rapid tests of significance without laboriously calculating the exact value of the statistic to be tested. It is a common error to draw a sharp line of distinction between the "significant" and the "non-significant," as though truth and a twenty-to-one chance were precisely equivalent, and the retention in computations of more figures than the accuracy of the original data warrant is a fault more common, if less serious, than the retention of too few. Unfortunately Dr. Mather does not always adhere in the text to the policy suggested by the tables.

The book as a whole is well produced and, for the most part, free from the minor typographical errors which are so irritating in a statistical work. The wide variety of sources of numerical examples should interest readers who are glad of a change from books more strictly concentrating on agricultural field trials.

D. J. FINNEY.

2.—*The Population of Bristol*. By H. A. Shannon and E. Grebenik. Cambridge University Press. 1943.  $9\frac{1}{2}'' \times 6\frac{1}{2}''$ . 92 pp. 7s. 6d.

This is the second of the "Occasional Papers" published by the National Institute of Economic and Social Research. This study is highly welcome, as it gives us valuable information which cannot be acquired from the official publications. As the research was limited to population figures for Bristol, the conclusion need not necessarily apply to other towns or areas; however, in connection with material based on recent surveys for other districts, it is possible to picture the general population trends which prevail in the industrial centres of the country. For instance, as Professor Hamilton Whyte points out in the introduction, Bristol, according to this study, seems to be no exception to the phenomenon that, thanks to net migration, the numbers of the resident population continued to increase even when the community was failing to reproduce itself.

H. A. Shannon deals with Migration and the Bristol Area, covering the period of 1861–1931, and with the population movements in the years 1931–38. The latter period shows a considerable difference since 1934; whereas during the period of 1931–34 there was an annual inward migration movement of about 600 a year, in the following four years this figure increased to 1700 a year owing to the expansion of armament factories.

In a further chapter the Influx of Labour is investigated for the years 1920–38. Mr. Shannon shows that male and female migrants suffered more from unemployment than the native Bristol workers. There is a note on the maldistribution of the industrial population of Bristol. Employment in aircraft works was and is disproportionately high, and this must necessarily set problems of adjustment to the area when peace comes.

E. Grebenik contributes the chapter: "Some Aspects of Population in Bristol," a paper written for the Royal Statistical Society in 1940, and gives "Future Estimates of Population."

The estimated future population of Bristol, other things being equal, shows a decline from 1947 onwards unless inward migration should fill the gap, but Mr. Grebenik doubts that such a migration will take place. Although his estimates of percentage distribution for the rest of this century show a definite decline in the percentage of children and a corresponding increase in the percentage of those over 65 years, it is very important to know that the percentage of persons in the age group 15-64, that is, the proportion of the working population, does not show any substantial decrease; "thus the fear that the burden of maintaining a declining population will fall on a smaller proportion of the population than is the case to-day is seen to be unfounded."

However, the expected decline of the future population of Bristol would have great repercussion on housing, the provision of schools, hospitals, transport, and many other relevant items based on the population factor. A decrease in the number of inhabitants over the next sixty years to two thirds of what it was before the war would be a very serious fact; this would be the result if the present levels of fertility and mortality continued. But, as the author points out, it can be taken for granted that there will be changes in both rates.

On page 74 a very interesting table shows the proportion of children of various parity orders for Bristol, Stockport and Glasgow, the latter for the year 1913. The percentage of first-born children in 1937 was 43.13 in Bristol and 39.71 in Stockport, compared with 37.47 in Bristol for the year 1932. Most striking is the contrast with Glasgow for the year 1913, where only 14.14 per cent. were first-born children. Although the Glasgow figures are not made up in quite the same way as those for the other towns, the discrepancy is most elucidating for the change in fertility which has taken place in the inter-war period. Another table shows the proportion of children of various parity orders in different occupational groups of the population, from the professions down to the unskilled manual worker. The latter group differs notably in many respects from the other groups; "the ages of the mothers at their first three confinements are lower on the average than the corresponding ages in all other groups, the dispersion of the distribution of mothers' ages is higher, and the parity pattern of the class as a whole is different from that of other classes, there being a much higher proportion of children of high parity order."

The fact is most depressing that this group of unskilled workers, who rear on the average by far the largest families, has to endure more unemployment and poverty than the other groups. According to the Bristol Social Survey, roughly 30 per cent. of this group were below the poverty line, compared with 17 per cent. of the group of semi-skilled workers, and 10 per cent. in other groups.

Studies like these are most revealing and provide us with material urgently needed by students of the social sciences. The authors of the book can be congratulated on their extremely valuable contribution to demographic studies.

M. J. E.

3.—*The Social Framework: an Introduction to Economics.* By J. R. Hicks. Oxford University Press. 1942. 7" x 5". xii + 212 pp. 7s. 6d.

Amongst introductory books on economic science—and their name is legion—Professor Hicks's new work will certainly occupy an important position. In a book primarily intended for the uninitiated it is not usual to find such wealth of originality, especially when this is coupled with a lucid, and often fascinating exposition of the elementary notions.

The great novelty in this work is that Professor Hicks introduces the national income as a kind of framework to which the fundamental economic concepts can be related. The traditional dilemma of how to begin the study of economics is still there: descriptive economics would be a dull collection of data for the beginner, while the theory of value would strike him as a set of abstract speculations without significance. Professor Hicks is successfully outflanking the problem, as his suggested method is to discuss the anatomy of the economic

system first, which would then lead the student "on to the 'physiological' side of economics whose centre is the theory of value."

The study of "Social Accounting" is therefore the main subject of this book. A continuous reference to the nation's balance sheet will undoubtedly be of great help to the student in assorting his newly acquired ideas and, at the same time, make the book intensely topical. Recent statistical and economic researches are mainly responsible for the fact that the economist is in a position to-day to present the fundamental concepts associated with the idea of the national income in a neat crystallized form. The author is right in acknowledging this, although the main reason why this particular entry into the economic labyrinth should appeal to the public more than any other is entirely due to the quite exceptional publicity which the problems have received during the present war.

Perhaps the greatest advantage of the study of "Social Accounting" is that here statistical data and economic theory are entirely co-ordinated: theory explains the figures just as much as figures illustrate the theory. But, of course, the pitfalls are numerous. Professor Hicks (mostly employing data for the year 1938) avoided these with great skill. It is, for instance, noteworthy that he refrained from making deductions for death duties when discussing "available income". On the other hand, where he has attempted to divide the national income into the shares of "Capital" and of "Labour" (and generally the whole argument in Appendix E), apportioning direct taxation between the two, he is on very thin ice indeed.

However, to raise statistical objections of this nature would do less than justice to the main purpose of this book, the skilful execution of which will be acclaimed by teachers and students alike.

G. A. B.

4.—*A History of the Straw Hat Industry*. By John G. Dony, Ph.D. Luton. Leagrave Press, Gibbs Bamforth & Co., 1942. 8½" x 5½". 219 pp., with maps, photos, statistical tables, bibliography and index. 10s. 6d.

As Dr. C. R. Fay has stated in the *Economic Journal* (April 1943, p. 91), it would be hard to find a more satisfying local history, and he stresses the value of its pictures of the past from 1681 onwards. The present reviewer's report to the Royal Labour Commission, which preceded the creation of the Labour Department of the Board of Trade in 1893, was naturally one of the first attempts to give some kind of statistical basis after the introduction of power-driven machinery. The interval of fifty years has been a kind of marking time, during which the whole question of home industries involving high skill and lightened by the use of electric power in country districts has been allowed to rest. Ruskin has fallen into well-deserved neglect. During the next twenty years Russia and Canada will probably (quite rightly) regard him as the greatest seer in the nineteenth century. The straw-hat trade at the moment is of no importance to anyone. But Dr. Dony's account of the efforts of factory inspectors, insurance officers and trade boards to urbanize the minds and will of women who choose seasonal trades because they can be fitted in with the normal occupations of their lives, should be studied by everyone who cares about the future of the crafts in relation to the towns.

C. E. C.

5.—*Inter-American Statistical Yearbook, 1942*. Edited by Raul C. Migone, under the auspices of the Argentine Commission of High International Studies. New York. The Macmillan Company. 1943. 11½" x 8". 1066 pp. \$10.

This is the second edition of a truly monumental work, improved, amplified and brought up to date as far as present circumstances permit. The book, the first edition of which was planned to mark the semi-centennial of the Pan-American Union, is intended primarily to inform the New World about itself, and is in four languages throughout: Spanish, English, Portuguese, and French. It presents a copious compilation of statistics derived in general from other compilations—its sources are the great international statistical works, the

*L.N. Statistical Yearbook*, the *Yearbook of Labour Statistics*, etc., and national official publications—arranged in the way most likely not only to give information concerning particular countries or commodities, but further to show the position of each country as it affects, and in relation to, the rest of the Americas. While the majority of elements bearing on national economy are illustrated, ranging through population questions, agricultural and industrial production, transport, commerce, labour, social questions, money and public finance, armed forces, and international treaties, the main purpose is to provide the material for a detailed examination of all aspects of trade. The *Yearbook* is clearly the result of great labour, and will no doubt be improved and enlarged from year to year. A major opportunity for improvement lies in the elimination of misprints, a serious flaw in a work of this kind. The English translation also might be bettered.

This compilation is the only source available to countries speaking Spanish or Portuguese for a great deal of the information, which may be in many opinions the most important purpose that it serves. For readers in this country, however, it presents a useful source of some information which is difficult to come by, and the most complete statistical treatment of New World conditions in a single volume. If we are to look to a post-war world in which some effort is made to improve upon the economic chaos of the inter-war period, books such as this, which give in a convenient form the information on which policy and public opinion must be based, are of great importance.

W. M. II.

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## STATISTICAL NOTES

## 1. BRITISH OFFICIAL STATISTICS

THERE was little change during the first three months of 1943 in the general level of *wholesale prices*, the Board of Trade index-number advancing only about 0.5 per cent. The average allocation price of tea was advanced in January 4*d.* per lb. (roughly about 18 per cent.), and a rise of 1*s.* per ton in the prices of coal took place on January 1st. In February raw cotton was reduced 1*d.* per lb. to compensate for the advances in the wages of spinners and weavers. The reduction represents about 11½ per cent. in the price of American cotton and 8½ per cent. in that of Egyptian. Altogether the reduction in the index-number for cotton and cotton manufactures over the quarter represents a fall of about 2.7 per cent.\* The price levels of iron and steel, coal, non-ferrous metals and of wool remained stationary throughout the three months, and those of the other groups advanced very little, and mostly under 1 per cent.

The following table gives the Board of Trade index-number of wholesale prices for the four months December 1942 to March 1943, with comparative figures for certain earlier months.

(Averages of 1930 - 100)

Date	Total Food	Total not Food	All Articles	Basic Materials (Excluding Fuel)	Intermediate Products	Manufactured Articles	Building Materials
Dec. 1942 ...	159.0	162.0	161.3	169.9	171.2	153.7	147.7
Jan. 1943 ...	159.7	163.0	162.1	171.5	171.2	154.2	147.9
Feb. " ...	159.8	162.9	162.1	172.1	170.8	153.7	147.9
March " ...	160.0	163.0	162.2	172.2	170.9	153.9	148.0
March 1942 ...	157.9	158.9	158.8	168.3	167.9	151.7	142.9
" 1941 ...	144.1	153.9	150.8	163.6	163.6	147.3	137.7
" 1940 ...	123.7	131.1	128.8	140.4	131.9	129.0	114.3
Aug. 1939 ...	90.1	102.2	98.1	94.5	104.0	108.7	104.1
Percentage increase in March 1943 over—							
March 1942 ...	1.3	2.5	2.1	2.3	1.8	1.4	3.6
" 1941 ...	11.0	5.9	7.6	5.3	4.5	4.5	7.5
" 1940 ...	29.3	24.0	25.9	22.6	26.7	19.3	29.5
Aug. 1939 ...	77.0	59.5	65.3	82.2	64.2	41.5	42.2

It will be seen that over the whole period of the war wholesale prices of basic materials have increased 82.2 per cent., of food and tobacco 77 per cent., of industrial materials and manufactures 59.5 per cent., and the general level of

\* Since the publication in Part IV of the *Journal* for 1942 of the Board of Trade index-number a revision has taken place owing to the substitution of "utility" cotton cloths for those previously included in the index-number. The revision affects the index-numbers for cotton, industrial materials and manufactured articles, and also the general index-number (see table at end of article).



wholesale prices of all articles included in the index-number 65·3 per cent. The largest increase in any one group was in that of cereals, which showed a rise of 123·4 per cent., and the smallest in that of non-ferrous metals, which has advanced only 25 per cent., but these metals have been controlled both as to price and supply over nearly the whole of the period.

The following table shows the revised figures for certain group totals in the Board of Trade index-number and should be substituted for those appearing in the issues of the Society's *Journal* for 1942. See note \* on page 73.

Date	Index Numbers for			Total (All groups)
	Cotton	Industrial Materials, etc.	Manufactured Articles	
April 1942 ... ..	140·0	158·9	151·4	159·5
May " ... ..	140·0	159·0	151·4	160·5
June " ... ..	140·0	158·9	151·5	159·6
July " ... ..	140·0	160·3	151·9	160·0
Aug. " ... ..	140·0	160·4	152·6	158·8
Sept. " ... ..	140·0	161·1	153·2	158·9
Oct. " ... ..	140·0	161·7	153·6	159·9
Nov. " ... ..	140·0	161·9	153·7	160·8
Dec. " ... ..	140·0	162·0	153·7	161·3

The figures for other British index-numbers of wholesale prices, together with that of the United States Bureau of Labour, are given below:

Date	Board of Trade (1930 = 100)	<i>Economist</i> (1927 = 100)	<i>Statist</i> (1906-77 = 100)	<i>The Times</i> (1913 = 100)	U.S. Bureau of Labour (1926 = 100) *
Dec. 1942 ... ..	161·3	112·7	152·2	176·8	100·6
Jan. 1943 ... ..	162·1	113·5	153·3	178·4	101·5
Feb. " ... ..	162·1	113·4	153·2	178·1	102·3
March " ... ..	162·2	114·2	154·0	178·6	103·1
March 1942 ... ..	158·8	110·3	153·5	179·1	97·1
" 1941 ... ..	150·8	104·3	138·0	166·1	87·1
" 1940 ... ..	128·8	92·6	123·4	145·1	78·1
Aug. 1939 ... ..	98·1	70·3	90·4	114·5	74·8
Percentage increase in March 1943 over—					
March 1942 ... ..	2·1	3·6	0·3	0·3 †	6·2
" 1941 ... ..	7·6	9·5	11·6	7·4	27·1
" 1940 ... ..	25·9	23·3	24·8	23·1	32·0
Aug. 1939 ... ..	65·3	62·4	70·4	56·0	37·8

\* Mean of weekly prices.

† Decrease.

During the first three months of 1943 there has been little general change in the *cost-of-living* index-number of the Ministry of Labour and National Service, which is based on the retail prices of the principal items of consumption of working-class families. Among the articles of food the only change has been an increase of 4d. per lb. in the retail price of tea. As regards clothing, there has been a continued decline in price since August 1942 owing to the largely increased sales of utility cloth and apparel as compared with those of non-utility articles of corresponding quality at higher prices. The consequent decline in the prices of clothing and apparel since August 1st, 1942, was at April 1st, 1943, about 12 per cent., and the decrease seems likely to continue in consequence of the increasing supply of utility articles.

The following table sets out the index-numbers for the various groups of articles prices at July 1914 being taken as 100.

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items	All Items
Jan. 1st, 1943 ...	164	164	370	244	268	199
Feb. 1st, " ...	164	164	365	244	268	199
March 1st, " ...	165	164	360	244	268	199
April 1st, " ...	165	164	355	244	268	198
April 1st, 1912 ...	160	161	405	232	235	199
Sept. 1st, 1939 ...	138	162	205-210	180-185	180	155
Percentage increase in April 1943 over—						
Sept. 1st, 1939 ...	20	1	71	34	50	55

Apart from a slight seasonal increase in January 1943, *unemployment* continues to decline, and the numbers of unemployed on the registers of the employment offices of the Ministry of Labour and National Service had at April 12th fallen to 80,091, compared with 127,499 on April 13th, 1942. Nearly all of the number registered for unemployment were merely in the process of changing jobs or those recently recovered from ill-health. The slight increase in January in the number of men and women unemployed was principally due to seasonal causes, and the increase in the number of juveniles was mainly due to the registration of school-leavers at the end of the Christmas term. In addition to the numbers recorded as unemployed at April 12th, 1943, there were 21,026 men classified as unsuitable for ordinary industrial employment, and 643 women unsuitable for normal full-time employment. The numbers registered as unemployed in April 1940 and in August 1939 presumably include men and women of similar calibre but the number is not ascertainable. In April 1941 the numbers were 36,915 men and 3,797 women. In April 1942 such men and women were excluded from the figures. The next count of unemployed will not be taken until the middle of July 1943 and thereafter quarterly.

The table below gives the numbers recorded as unemployed at recent dates.

Date	Wholly Unemployed	Temporarily Stopped	Persons normally in casual employment	Total	Males	Females
Dec. 14th, 1942 ...	81,943	2,023	2,858	86,824	57,053	29,771
Jan. 12th, 1943 ...	93,708	3,114	2,195	99,017	61,709	37,308
April 12th, „ ...	76,769	1,312	2,010	80,091	53,838	26,253
<i>April 13th, 1942 ...</i>	<i>117,018</i>	<i>6,181</i>	<i>3,970</i>	<i>127,169</i>	<i>76,519</i>	<i>50,650</i>
„ 21st, 1941 ...	318,772	75,373	16,366	410,511	211,519	198,992
„ 15th, 1940 ...	810,027	90,182	42,186	942,395	656,669	285,726
Aug. 14th, 1939 ...	968,108	211,978	51,606	1,231,692	917,099	314,593

Although, for reasons of national security, few Government statistics are published in war-time, the Ministry of Agriculture at a Press Conference held on June 17th, 1943, released certain figures as evidence of the *agricultural war effort*. The information in most cases is given as percentage changes in 1942 compared with pre-war figures. The precise base is not indicated, but would presumably be either 1939 or an average of 1937-39.

The total cultivated area is stated to have declined by 2 per cent., owing to the absorption of land for military and industrial uses, though there has been some gain by reclamation. This is roughly equal to about half-a-million acres on a total area of 24,700,000 acres of crops and grass in England and Wales. The arable area, which comprises all annual crops, bare fallow and temporary grass under rotation, has increased by 33·7 per cent.; taking the pre-war arable area as 8,900,000 acres this represents a gain of about 3 million acres transferred from the area under permanent grass. The total is comparable with the arable area cultivated in 1901-5. The acreage under "tillage," *i.e.*, the arable area without the temporary leys, has increased by 52·8 per cent., which means that the area actually under the plough has been enlarged at the expense of temporary grass.

Of individual crops, wheat is said to have increased by 35·6 per cent. and oats by 72 per cent., while cereals generally, which would include wheat, barley, oats, mixed corn and rye, have risen by 65·7 per cent. The potato acreage has been raised by 80·4 per cent., and that of vegetable crops by 55·1 per cent.

As regards livestock, cattle were more numerous in 1942 by 4·6 per cent., which on a total of 6,770,000 in 1939 represents a gain of 311,000 head. This it is explained reflects "the Government's insistence on milk as Priority Food, No. 1." Other kinds of livestock have diminished owing to the scarcity of imported feeding-stuffs, sheep by 17·8, pigs by 51·9, and poultry by 24·2 per cent. The supply of these imported foods is stated to have declined from 8,500,000 tons pre-war to 1,300,000 tons in 1942-3.

The net output from the soil of the United Kingdom measured in calories is estimated to be 70 per cent. higher than it was pre-war. This net output is the production from the land, excluding that part of the total output derived from imported feeding-stuffs. No pre-war figures of net output calculated in this way were published.

The increased use of machinery is shown by the fact that the number of tractors has increased from 55,000 in 1939 to 150,000 in 1942 and of tractor

implements from 200,000 to 1,175,000. There has been a slight fall in the number of regular male workers, but additional labour of other kinds has been obtained. The Women's Land Army numbered 58,000 in March 1943, while prisoners of war are employed and there has been a considerable increase in casual workers.

Among other figures given it may be noted that in 1942 35 per cent. of the total sugar consumed was home-grown, as compared with 23 per cent. pre-war. Increases in the wheat, barley and potato areas, and the ploughing up of an additional 1,250,000 acres of grass land are anticipated in 1943.

## 2. OTHER STATISTICS

The statistics of retail sales prepared by the Bank of England in conjunction with various retail distributors' Associations show that during the year February 1942 to January 1943 the value of the total sales showed an increase of 1.9 per cent. over the previous twelve months. The sales of food and perishables increased 3.5 per cent. and those of other merchandise declined 0.1 per cent. The principal decreases in the various merchandise groups were in hardware (10.8 per cent.), sport and travel goods (17.3 per cent.) and men's and boys' clothing (4.8 per cent.). On the other hand, there were increased sales of boots and shoes (3.1 per cent.) and of furnishing goods (3.3 per cent.). The value of stocks at cost at the end of January 1943 was 5.5 per cent. in excess of the value at the end of January 1942 (food and perishables 19.0 per cent., other merchandise 3.7 per cent.).

## OBITUARY

SIR ARTHUR NEWSHOLME, K.C.B.

THE death of Sir Arthur Newsholme removes a notable personality of the last generation, very familiar to many of our older fellows, who will recall his handsome figure and well-modulated voice. His career was characteristically British. Beginning as a general practitioner of medicine, he was attracted to public health work, became a whole-time Medical Officer of Health (Brighton) and ended his official life as head of the Medical Department of the Local Government Board (now Ministry of Health). When he retired from office in 1918, at the age of 61, his work was by no means over. He became visiting lecturer at the Johns Hopkins School of Hygiene in Baltimore and, after his return to England, his literary output during the last twenty-five years was considerable.

Newsholme's great public reputation was partly due to administrative ability, partly to his work in vital statistics. So long ago as 1889 he published a manual of Vital Statistics (a new and enlarged edition was published in 1924), which soon became the standard textbook for public-health students, and he was author, or joint author, of several papers which are of importance. Probably the best are the study of the alleged increase of mortality from cancer contributed (jointly with Mr. George King) to the *Proceedings of the Royal Society* in 1895, and a memoir on corrected birth rates, by himself and Dr. Stevenson, published in vol. lxix (1906) of our *Journal*.

Newsholme, like most statisticians, was occasionally engaged in controversies. It was said of him, not wholly without justice, that he sometimes used statistical methods rather to support conclusions based on other kinds of evidence than as primary means of discovery. His knowledge of the technique of constructing life tables was considerable and he gave special attention to graphical methods; he was less interested in modern biometric technique.

Newsholme's enthusiasm for public health was contagious; his steady support and encouragement of the late T. H. C. Stevenson, one of our great vital statisticians, would alone entitle him to general gratitude. There are others, still living, who owed much to Newsholme. He was elected into our Society in 1889, and served more than once on the Council between 1908 and 1926.

M. G.

# STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

## UNITED KINGDOM—

### *Agriculture—*

April 1943—Marginal and hill farming in Wales: *A. W. Ashby.*

### *Banker—*

March 1943—Competitive currency appreciation: *Paul Einzig.* Life Assurance in 1942: by a Correspondent.

April 1943—Multilateral clearing: *Paul Einzig.* Why Multilateral?

*Bankers' Magazine*—March 1943—Essentials for world economic advancement: *A. H. Gibson.* Bankers' clearings in 1942.

*Biometrika*—April 1943—Medical statistics from Graunt to Farr (concluded): *Major Greenwood.* The probability integral for two variables: *C. Nicholson.* Tables of percentage points of the inverted beta (F) distribution: *Maxine Merrington* and *Catherine M. Thompson.* Tables of the probability integral of the "studentized" range: *E. S. Pearson* and *H. O. Hartley.* Minimum range for quasi-normal distributions: *R. C. Geary.*

*Economica*—February 1943—The Scott Committee report: *D. H. Macgregor.* The rôle of expectations in economics as a social science: *L. M. Lachmann.* The fortune-teller: *Richard Stone.*

*Eugenics Review*—January 1943—Leonard Darwin, 1850–1943: Eugenic aspects of children's allowances: *Sir William Beveridge.*

*Institute of Bankers, Journal*, April 1943—Social security: *A. L. Bowley.*

### *Institute of Statistics, Oxford, Bulletin—*

Vol. 5, No. 3—Expenditure on food and nutrition: *T. Schulz.* Protein allocations: *R. S. G. Rutherford.* Natural versus Synthetic rubber: *S. Moos.*

Vol. 5, No. 4—Prices and rata in consumption in 1942: *G. D. N. Worswick.* The war-time trend of deposits: *M. Kalecki.*

Vol. 5, No. 5—Meat and wheat: *J. Goldmann.* The burden of the national debt: *M. Kalecki.*

Vol. 5, No. 6—The trend of consumption in 1942: *T. Schulz.* The Budget: *M. Kalecki.*

*Public Administration*—April 1943—Post-entry training for administration from the industrial aspect: *E. S. Byng.* The education of the Civil Servant: *Harold J. Laski.* Post-entry training for administration from the public services aspect: *L. C. White.*

### *Royal Meteorological Society, Quarterly Journal—*

April 1943—Meteorological observations at the Royal Observatory, Greenwich, during the year 1942. The reactions of the human body to its physical environment: *D. Brunt.* Soaring flight (discussion).

*Sociological Review*—July–October 1942. Loudoun Square: A community survey—II: *K. L. Little.* Notes on class consciousness and class unconsciousness: *Tom Harrison.* The social basis of physical planning—II: *Robert E. Dickinson.* Jewish students at the Universities of Great Britain and Ireland—excluding London, 1936–1939: *Geoffrey D. M. Block.*

## AUSTRALIA—

*Economic Record*—December 1942—The uniform income tax in Australia: *H. S. Carslaw.* Taxation reform in Australia: *K. M. Laffer.* Some aspects of price stabilization in New Zealand: *H. L. Wise.*

## INDIA—

*Indian Journal of Economics*—October 1942—International equilibrium in a complementary economy: *Anil Datta*. The Indian fiscal policy: *A. K. Dasgupta*.

## UNION OF SOUTH AFRICA—

*South African Journal of Economics*—March 1943—The concept of waste: *W. H. Hutt*. A critique of the first report of the social and economic planning council: *W. H. Hutt*.

## UNITED STATES—

*American Economic Review*—March 1943—Aspects of Government borrowing: *M. Mitnitzky*. The capital budget and the war effort: *M. A. Copeland*. The spendings tax: The tax as a wartime measure: *Milton Friedman*. Problems of administration and equity: *K. E. Poole*. Problems in war finance: *Carl Shoup*.

*American Economic Review—Supplement*—March 1943—Papers and Proceedings of the Fifty-fifth Annual Meeting of the American Economic Association, January 1943.

*American Statistical Association, Journal of*—March 1943—Some reflections—Statistical and other—on a non-material universe: *Alfred J. Lotka*. Statistical laws of family expenditure: *Holbrook Working*. Practical applications of theoretical sampling methods: *John N. Webb*, *M. Starr Northrop*, and *Stanley L. Payne*. Some sampling uses of data from the census of agriculture: *Irving Holmes*. Marketing and sampling uses of population and housing data: *A. Ross Eckler* and *E. P. Staudt*. On the efficiency of deep stratification in block sampling: *Benjamin J. Tepping*, *William N. Hurwitz*, and *W. Edwards Deming*.

*Annals of the American Academy of Political and Social Science*—January 1942—The press in the contemporary scene—whole number.

*Annals of Mathematical Statistics*—March 1943—Some new methods in matrix calculation: *Harold Hotelling*. On solutions of the Behrens-Fisher problem, based on the *t*-distribution: *Henry Scheffe*. An extension of Wilks' method of setting tolerance limits: *Abraham Wald*. Asymptotic formulas for significance levels of certain distributions: *Alfred M. Peiser*. Generalization of Poincaré's formula in the theory of probability: *Kai Lai Chung*. Tables for testing randomness of grouping in a sequence of alternatives: *Frieda S. Swed* and *C. Eisenhart*.

*Harvard Business Review*—Spring number, 1943—Concentration of production: *Arthur Robert Burns*. Britain to-day: *Thomas North*. Investment in China's postwar industry: *Kuang Tai Hu*. Transportation for war: *George E. Talmage*.

*Journal of Political Economy*—December 1942—Monetary effects of wartime social security taxes: *Alex Moses Rosenson*. White Paper on British war finance, 1938–41: *Richard A. Musgrave*. Malthus and Keynes: *James J. O'Leary*.

February 1943—Ability of the banking system to absorb Government bonds: *James C. Dole*. The contribution of life insurance to the savings stream: *Paul Geren*. Myths and illogic in popular notions about business cycles: *Richard C. Bernhard*.

April 1943—Four years of Fair Labor Standards Act of 1938: Some problems of enforcement: *Irving Richard*. Social security taxes in the war finance program: *C. Ward Macy*. The co-ordination problem in war economy: *E. Ronald Walker*. War and economics: a review article: *J. B. Condliffe*.

*Millbank Memorial Fund Quarterly*—January 1943—The cost of tuberculosis control in the Department of Health, New York City, 1940. The age-sex composition of the population resulting from natality and mortality conditions: *J. Yerushalmy*.

UNITED STATES - *Contd.*

*Quarterly Journal of Economics*—February 1943. Demand interrelations for selected agricultural products: *Marion Clawson*. Wages and the movement of factory labor: *W. Rupert Maclaurin* and *Charles A. Myers*. Balance of payments problems of countries reconstructing with the help of foreign loans: *J. J. Polak*. Trends in German economic control since 1933: *Sidney Merlin*.

*Review of Economic Statistics*—February 1943—Essays in honor of Joseph A. Schumpeter.

*Social Research*—February 1943—The shipping problem at the end of the war: *Kurt Lachmann*. Functional finance and Federal debt: *Abba P. Lerner*.

*Wheat Studies*—December 1942—Wheat in the third war year: Major developments, 1941-42: *M. K. Bennett*, *Helen C. Farnsworth* and *Rosamond H. Peirce*.

January 1943—World wheat survey and outlook, January 1943: *M. K. Bennett*, *Helen C. Farnsworth* and *V. P. Timoshenko*.

March 1943—Variability in wheat yields and outputs: *V. P. Timoshenko*.

## INTERNATIONAL—

*International Labour Review*—

March 1943—The rôle of food in post-war reconstruction: *Sir John Boyd Orr*. Swedish social policy in wartime: *Tage Erlander*. The recruitment of French Labour for Germany.

April 1943—The co-operative movement and post-war reconstruction: *James McFadyen*. A post-war programme for the United States. The work of the factory department in Great Britain.



## LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part IV, 1942, the Society has received the publications enumerated below:—

## I.—OFFICIAL PUBLICATIONS

## (a) United Kingdom

*Agriculture and Fisheries, Ministry of.*

Agricultural Improvement Council for England and Wales. First report (covering the period to June 30th, 1942). London: H.M.S.O., 1943.  $9\frac{1}{2}'' \times 6''$ . 18 pp. 3d.

Farmers' income tax. London: H.M.S.O., 1943.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 27 pp. 3d.

Report of the committee on post-war agricultural education in England and Wales. London: H.M.S.O., 1943. Cmd. 6433.  $9\frac{1}{2}'' \times 6''$ . 92 pp. 1s. 6d.

*Agricultural Research, Committee of the Privy Council for the Organisation and Development of.* Agricultural research in Great Britain. London: H.M.S.O., 1943. Cmd. 6421.  $9\frac{1}{2}'' \times 6''$ . 100 pp. 1s. 6d.

*Colonial Office.*

Colonial Development and Welfare Act 1940. Report on the operation of the Act to October 31st, 1942. London: H.M.S.O., 1943. Cmd. 6422.  $9\frac{1}{2}'' \times 6''$ . 14 pp. 3d.

Development and welfare in the West Indies 1940-42. Report by *Sir Frank Stockdale*. London: H.M.S.O., 1943.  $9\frac{1}{2}'' \times 6''$ . iv + 93 pp. 1s. 6d.

Jamaica constitution. Despatch from the Secretary of State for the Colonies to the Governor of Jamaica, 1943. London: H.M.S.O., 1943. Cmd. 6427.  $9\frac{1}{2}'' \times 6''$ . 14 pp. 3d.

Labour conditions in Ceylon, Mauritius, and Malaya. Report by *Major G. St. J. Orde Browne*. London: H.M.S.O., 1943. Cmd. 6423.  $9\frac{1}{2}'' \times 6''$ . 113 pp. 2s.

*Education, Board of. Scottish Education Department.* Youth registration in 1942. London: H.M.S.O., 1943. Cmd. 6446.  $9\frac{1}{2}'' \times 6''$ . 28 pp. 6d.

*Foreign Office.*

Final Act of the United Nations Conference on Food and Agriculture, Hot Springs, Virginia, United States of America, May 18th-June 3rd, 1943. (Miscellaneous, No. 3.) London: H.M.S.O., 1943. Cmd. 6451.  $9\frac{1}{2}'' \times 6''$ . 40 pp. 9d.

Proposals for the reform of the foreign service. (Miscellaneous, No. 2, 1943.) London: H.M.S.O., 1943. Cmd. 6420.  $9\frac{1}{2}'' \times 6''$ . 10 pp. 2d.

*Forestry Commission.* Post-war forest policy: report by H.M. Forestry Commissioners. London: H.M.S.O., 1943. Cmd. 6447.  $9\frac{3}{4}'' \times 6''$ . 114 pp. 2s.

*Health, Ministry of.*

First report of Nurses Salaries Committee. Salaries and emoluments of female nurses in hospitals. London: H.M.S.O., 1943. Cmd. 6424.  $9\frac{1}{2}'' \times 6''$ . 42 pp. 9d.

Supplement to first report of Nurses Salaries Committee: notes on application of scales of salary (with examples): for the guidance of hospital authorities. London: H.M.S.O., 1943.  $9\frac{1}{2}'' \times 6''$ . 36 pp. 6d.

The radiological appearances of early pulmonary tuberculosis by *R. R. Trail* and *P. Kerley*. London: H.M.S.O., 1943.  $9\frac{1}{2}'' \times 6''$ . 8 pp. 2d.

*India Office.*

East India (Census 1941): abstract of tables giving the main statistics of the census of the Indian Empire of 1941, with a brief introductory note. London: H.M.S.O., 1943. Cmd. 6435.  $9\frac{1}{2}'' \times 6''$ . 16 pp. 3d.

India: statement published by the Government of India on the Congress Party's responsibility for the disturbances in India 1942-43. London: H.M.S.O., 1943. Cmd. 6430.  $9\frac{1}{2}'' \times 6''$ . 76 pp. 1s. 3d.

## (a) United Kingdom—Contd.

*Labour and National Service, Ministry of.*

Conference on Industrial Health: Caxton Hall, Westminster, April 9th, 10th and 11th, 1943; report of proceedings. London: H.M.S.O., 1943. 9½" × 6". 107 pp. 1s. 6d.

Third report of the Board of Investigation into wages, and machinery for determining wages and conditions of employment in the coal-mining industry. London: H.M.S.O., 1943. 9½" × 6". 16 pp. 3d.

— and Ministry of Works. Training for the building industry. London: H.M.S.O., 1943. Cmd. 6428. 9½" × 6". 6 pp. 1d.

*Medical Research Council.*

Special Report Series No. 247. Epidemiology of diphtheria during the last forty years. By W. T. Russell. London: H.M.S.O., 1943. 9½" × 6". 52 pp. 1s.

War Memorandum No. 2. Notes on gas gangrene: prevention, diagnosis, treatment; with an account of the technique of wound-excision and a scheme for the bacteriological investigation of war wounds. (By the War Wounds Committee of the Medical Research Council and the Committee of London Sector Pathologists. Rev. 2nd ed.) London: H.M.S.O., 1943. 9½" × 6". 28 pp. 6d.

— No. 7. Nerve Injuries Committee. Aids to the investigation of peripheral nerve injuries. London: H.M.S.O., 1942. 9½" × 6". 48 pp. 2s.

— No. 8. Committee on the Care of Shipwrecked Personnel. A guide to the preservation of life at sea after shipwreck. London: H.M.S.O., 1943. 9½" × 6". 21 pp. 4d.

— No. 9. The determination of blood groups. London: H.M.S.O., 1943. 9½" × 6". 19 pp. 4d.

*Scotland.—Department of Health.*

Scottish Nurses Salaries Committee. Interim report. Edinburgh: H.M.S.O., 1943. Cmd. 6325. 9½" × 6". 16 pp. 3d.

— second report. Edinburgh: H.M.S.O., 1943. Cmd. 6439. 9½" × 6". 28 pp. 6d.

*Scottish Office.* Utilization of land in the rural areas of Scotland: report of a committee appointed by the Secretary of State for Scotland in reference to the recommendations of the Committee on Land Utilisation in Rural Areas in England and Wales. Edinburgh: H.M.S.O., 1943. Cmd. 6440. 9½" × 6". 4 pp. 1d.

*Select Committee on National Expenditure.*

Session 1942–1943. Reports: 4th—Public relations branches of service departments. 8 pp. 2d. 5th—Home flax production. 12 pp. 2d. 6th—Payment of fire guards. 5 pp. 1d. London: H.M.S.O., 1943. 9½" × 6". 3 parts.

*Pensions, Ministry of.*

Order by His Majesty for retired pay, pensions, allowances and gratuities for members of the Air Force and of the Nursing and Auxiliary Services thereof disabled and for the widows, children and dependants of such members deceased, in consequence of the present war. London: H.M.S.O., 1943. 9½" × 6". 40 pp. 9d.

Royal warrant for the retired pay and pensions, etc., of members of the military forces disabled, and of the widows, children and dependants of such members deceased, in consequence of the present war. London: H.M.S.O., 1943. Cmd. 6419. 9½" × 6". 36 pp. 6d.

*Production, Ministry of.* Report on the work of the Combined Raw Materials Board to January 26th, 1943. London: H.M.S.O., 1943. 9½" × 6". 2d.

*Supply, Ministry of.* The raw materials guide. December 1942. London: H.M.S.O., 1943. 9½" × 6". 75 pp. 1s.

*Treasury.*

An analysis of the sources of war finance and an estimate of the national income and expenditure in 1938, 1940, 1941 and 1942. London: H.M.S.O., 1943. Cmd. 6438. 9½" × 6". 26 pp. 6d.

Proposals for an international clearing union. London: H.M.S.O., 1943. Cmd. 6437. 9½" × 6". 20 pp. 4d.

*War Transport, Ministry of.* Government control of railways: estimate of the pooled revenue of the controlled undertakings for the year ended December 31st, 1942. London: H.M.S.O., 1943. Cmd. 6436. 9½" × 6". 2 pp. 1d.

## (a) United Kingdom—Contd.

*Works, Ministry of.*

The standard of wartime building. London: H.M.S.O., 1943. 9½" × 6". 34 pp. 9d.

Third report of the Committee on the Brick Industry. London: H.M.S.O., 1943. 9½" × 6". 52 pp. 9d.

*Works and Planning, Ministry of.* Central Council for Works and Building, Education Committee. Report on training for the building industry. London: H.M.S.O., 1942. 9½" × 6". 56 pp. 1s.

*War Office.* Report of the Committee on Voluntary Aid Detachments. London: H.M.S.O., 1943. Cmd. 6448. 9½" × 6". 23 pp. 4d.

## (b) British Empire

## Australia—

*New South Wales. Parliament.* Estimate of the expenditure of the government of New South Wales on account of public works and other services, for the years 1941–42 proposed to be provided by loan. Sydney: 1942. 13" × 8½". 12 pp. 10d.

## Canada—

*Province of Ontario.* Budget address delivered by the Hon. A. St. Clair Gordon, Treasurer of the Province of Ontario in the Legislative Assembly of Ontario Friday, March 19th, 1943 . . . also statements of assets and liabilities, revenue and expenditure, comparative and statistical information. Toronto: T. E. Bowman, 1943. 9¾" × 6½". 71 pp.

## Union of South Africa—

*Office of Census and Statistics.* Sixth census of the population of the Union of South Africa, enumerated May 5th, 1936. Volume IX, Natives (Bantu) and other Non-European races. Pretoria: 1942. 12" × 10". xlix + 153 pp. 7s. 6d.

## (c) Foreign Countries

## Brazil—

*Departamento Nacional do Café. Secção de Estatística.* Anuário estatístico do café 1939–40. Rio de Janeiro: 1941. 10¾" × 7½". xcii + [4] + 1369 pp.

## Chile—

*Dirección General de Estadística.* Finanzas, bancos y cajas sociales. Año 1941. Valparaíso: 1942. 10½" × 7½". vi + 149 pp. \$40.

## Portugal—

*Instituto Nacional de Estatística.* Análise estatística de alguns aspectos monetários portugueses, por Amaro D. Guerreiro. (Estudos). Lisboa: 1943. 10½" × 7½". 12 pp.

## Spain—

*Ministerio de Trabajo. Dirección General de Estadística.* Anuario estadístico de España. Edición manual, 1942. Madrid: 1942. 6" × 4½". xxxv + 806 pp.

## United States of America—

*Childrens Bureau.* White House conference on children in a democracy. Washington, D.C. January 18–20, 1940. (Publication No. 272) Washington: Superintendent of Documents, 1942. 10" × 7". xxii pp. 65 c.

*Department of Commerce. Bureau of Foreign and Domestic Commerce.* Survey of current business: 1942 supplement. Washington: 1942. 11½" × 9". 271 pp. 50c. (From Mrs. Hamilton.)

## United States of America—Contd.

*National Resources Planning Board.* A post-war plan and program for the United States of America: issued by the National Resources Planning Board, Washington, D.C. Washington: Government Printing Office, 1943. (London: H.M.S.O.), 1943. 9½" x 6". 103 pp. 1s.

*Treasury.* United States proposal for a united and associated nations stabilization fund. Preliminary draft outline released by the United States Treasury for publication April 7th, 1943. Reprinted by His Majesty's Stationery Office, London, 1943. 9½" x 6". 12 pp. 3d.

## (d) International

## League of Nations —

*Economic, Financial and Transit Department.* Relief deliveries and relief loans 1919–1923. (I. Economic and Financial, 1943. II. A. 1.) Geneva: 1943 (London: Allen & Unwin). 9" x 6". 62 pp.

The transition from war to peace economy: report of the Delegation on Economic Depressions: Part I. (II. Economic and Financial, 1943. II. A. 3.) Geneva: 1943. 9" x 6". 118 pp.

## International Labour Office—

*Studies and Reports, Series D (Wages and Hours of Work), No. 23.* Labour conditions in war contracts: with special reference to Canada, Great Britain and the United States: 2nd ed. Montreal: 1943. (London: P. S. King & Staples.) 9" x 6". ii + 74 pp. 1s.

—Series N (Statistics), No. 25 (Revision of No. 19). The international standardization of labour statistics: a review of the statistical work of the International Labour Office and of various international statistical conferences. Montreal: 1943. 9" x 6". vii + [1] + 169 pp. 4s.

*Year book of labour statistics.* Seventh year, 1942. Montreal: 1943. (London: P. S. King.) 12" x 8½". xii + 222 pp. 8s.

## II.—AUTHORS AND MISCELLANEOUS

Association of Scientific Workers. Planning of science. Report of proceedings of the open conference held at Caxton Hall January 30th–31st, 1943. London: 1943. 8½" x 5½". 127 pp. 2s. 6d.

*Barger (Harold) and Landsberg (Hans H.).* American agriculture, 1899–1939: a study of output, employment and productivity. (Publication No. 42.) New York: National Bureau of Economic Research, 1942. 9" x 6". xxii + 435 pp. \$3.

*Benham (Frederic).* Economics: a general textbook for students. 3rd ed. London: Pitman, 1943. 8½" x 6". xv + 534 pp. 10s.

*Dony (John G.).* A history of the straw hat industry. Luton: Gibbs, Bamforth & Co., 1942. 8½" x 5½". 219 pp. (Presented by Miss C. E. Collet.)

*Drolet (Godias J.).* Collapse therapy: trends in frequency and type of surgical procedures in the treatment of pulmonary tuberculosis; a statistical review of institutional experience during the five-year period 1937–1941. (Repr. from the *American Review of Tuberculosis*, Feb., 1943; pp. 184–215.) New York: 1943. 10" x 7". 32 pp. (From the New York Tuberculosis and Health Association.)

*Durius (Casimiro Fontes).* O Porto em 1940. Subsídios demográficos, económicos e financeiros referentes à Cidade do Porto e seu Distrito no ano dos Dois Centenários organizados por Durius, Porto: 1942. 9½" x 7¼". [28 pp. + 3 folded charts.] (From the author.)

*Fabricant (Solomon).* Employment in manufacturing, 1899–1939: an analysis of its relation to the volume of production. (Publication No. 41.) New York: National Bureau of Economic Research, 1942. 9" x 6½". xix + 358 pp. \$3.

*Fehr & Company (Frank).* Review of the oilseed, oil and oil cake markets for 1942. London: Frank Fehr & Co., 1943. 10½" x 8½". [5] + 68 pp. + 1 folded chart.

*Fisher (Ronald A.) and Yates (Frank).* Statistical tables for biological, agricultural and medical research. 2nd ed., revised and enlarged. London and Edinburgh: Oliver and Boyd, 1943. 11" x 8½". viii + 98 pp. 13s. 6d.

## Authors and Miscellaneous—Contd.

- Germán, Bernácer.** La expresión fundamental del valor del dinero. (Artículo publicado en el Vol. II, núms. 7-8 de la revista *Anales de Economía*.) Madrid. 9½" × 6½". 60 pp.
- Grebenik (E.).** The quantitative aspect of the British population problem: a survey. (Reprint from *The Review of Economic Studies*.) 9½" × 7¼". [10 pp.] (From the author.)
- Greenwood (Major).** Social and industrial environment and diseases: a lecture delivered in London on Feb. 23, 1943, under the Chadwick Trust. (Repr. from *The Lancet*, Mar. 13, 1943, p. 325.) 8½" × 5½". 12 pp. (From the author.)
- Hawkins (L. Whittam).** Cost accounts: an explanation of principles and a guide to practice. 10th ed. Potters Bar: Geo & Co., 1943. 8½" × 5½". 84 pp. [Forms and Appendix 20 pp.] 21s.
- Holzinger (Karl J.) and Harman (Harry H.).** Factor analysis: a synthesis of factorial methods. Chicago: University of Chicago Press, 1941. (London: Cambridge University Press.) 9½" × 7". xii + 417 pp. 30s.
- Illinois, University of.** College of Commerce and Business Administration. Bureau of Economic and Business Research. Directory of early American public accountants, by A. C. Littleton. (Bulletin Series No. 62.) Urbana: University of Illinois, 1942. 9" × 6". 39 pp.
- Effect of inventory methods on calculation of profits and income taxes, by Charles J. Gee. (Bulletin No. 63.) Urbana: University of Illinois, 1943. 9" × 6". 66 pp.
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**BANK OF ENGLAND**  
*Pursuant to the Act 7th and 8th Victoria, cap. 32 (1844),*  
 (000's omitted)

1	2	3	4	5	6	7	8
ISSUE DEPARTMENT						COLLATERAL COLUMN	
Liabilities	DAYS (Wednesdays)	ASSETS				Notes in Hands of Public	Minimum Discount Rate
Notes Issued		Govt. Debt (£11,016) and Govt. Securities	Other Securities	Gold Coin and Bullion	Silver Coin		
£		£	£	£	£	£	Per cent.
780,211	Jan. 7.....	778,300	1,685	211	16	719,829	2
780,211	" 11.....	778,318	1,660	211	16	713,711	
780,211	" 21.....	778,282	1,707	211	11	740,688	
780,211	" 28.....	778,091	1,891	211	16	712,437	
780,211	Feb. 4.....	778,228	1,759	211	13	716,112	
780,211	" 11.....	778,155	1,833	211	12	749,571	
780,211	" 18.....	778,101	1,797	211	12	718,611	
780,211	" 26.....	778,196	1,791	211	10	719,572	
780,211	Mar. 4.....	778,205	1,782	211	12	751,477	
780,211	" 11.....	778,221	1,763	211	13	753,571	
780,211	" 18.....	778,127	1,863	211	9	754,223	
780,211	" 26.....	778,130	1,861	211	9	755,067	
780,211	Apr. 1.....	778,137	1,855	211	8	758,805	
780,211	" 8.....	778,170	1,818	211	12	793,926	
780,211	" 15.....	778,068	1,931	211	8	767,110	
880,241	" 22.....	828,201	1,787	211	12	767,146	
880,241	" 29.....	828,136	1,853	211	11	771,154	
880,241	May 6.....	828,223	1,767	211	10	776,950	
880,241	" 13.....	828,018	1,968	249	13	780,177	
880,241	" 20.....	828,017	1,812	219	11	782,470	
880,241	" 27.....	828,129	1,857	242	11	788,639	
880,241	June 3.....	827,985	2,005	212	10	792,938	
880,241	" 10.....	827,760	1,979	242	261	793,726	
880,241	" 17.....	827,756	1,953	212	261	793,183	
880,241	" 21.....	827,482	2,054	212	511	796,010	
880,212	July 1.....	827,383	1,857	212	700	801,601	
880,212	" 8.....	827,408	1,828	212	704	807,438	
880,212	" 15.....	827,216	1,743	212	1,011	812,570	
880,242	" 22.....	827,198	1,792	212	1,010	815,258	
880,212	" 29.....	877,229	1,760	212	1,011	821,118	
880,212	Aug. 5.....	877,361	1,630	212	1,009	813,316	
880,212	" 12.....	877,273	1,711	212	1,013	814,472	
880,242	" 19.....	877,010	1,698	212	1,263	810,331	
880,212	" 26.....	876,980	1,763	212	1,257	828,563	
880,212	Sept. 2.....	877,107	1,632	242	1,281	830,077	
880,242	" 9.....	877,145	1,593	212	1,262	831,505	
880,242	" 16.....	877,199	1,612	242	1,259	831,120	
880,242	" 23.....	877,130	1,611	212	1,259	831,756	
880,212	" 30.....	877,206	1,630	212	1,261	836,029	
880,242	Oct. 7.....	877,093	1,613	212	1,264	813,241	
880,242	" 14.....	877,176	1,601	242	1,260	816,276	
880,212	" 21.....	877,261	1,459	212	1,260	817,030	
880,242	" 28.....	877,271	1,467	212	1,262	851,175	
880,212	Nov. 4.....	877,349	1,385	212	1,263	858,095	
880,242	" 11.....	877,313	1,427	212	1,260	863,200	
880,242	" 18.....	877,378	1,362	212	1,260	865,235	
880,242	" 25.....	877,566	1,174	242	1,260	870,033	
980,242	Dec. 2.....	947,526	1,213	212	1,261	877,515	
980,242	" 9.....	917,588	1,161	212	1,258	880,525	
980,242	" 16.....	948,017	1,223	212	760	908,323	
980,242	" 23.....	947,921	1,319	212	760	920,569	
980,242	" 30.....	947,965	1,276	212	769	917,965	

## WEEKLY RETURN

for Wednesday in each Week, during the Year 1942

(000's omitted)

9	10	11	12	13	14	15	16	17	18
BANKING DEPARTMENT									
Liabilities				DATES (Wednes- days)	Assets				Totals of Liabilities and Assets
Capital (£14,553) and Res.	Public Deposits	Bankers' Deposits	Other Deposits		Govt. Securi- ties	Dis- counts and Ad- vances	Other Securi- ties	Reserve (Notes and Coin)	
£	£	£	£		£	£	£	£	£
17,860	9,619	135,745	54,846	Jan. 7	176,863	6,407	24,096	80,704	238,070
17,889	6,664	133,760	53,416	" 11	141,553	6,025	24,311	86,840	211,729
17,611	15,022	130,071	53,730	" 21	142,178	6,253	24,401	39,902	212,734
17,929	10,220	145,430	57,435	" 28	156,888	8,246	27,658	38,243	231,035
17,952	7,349	127,772	58,171	Feb. 1	117,898	6,789	22,389	34,168	211,244
17,971	10,197	122,318	58,235	" 11	118,183	6,664	22,752	31,122	208,721
17,986	10,875	135,708	51,121	" 18	151,888	6,628	22,238	31,896	215,750
18,003	11,487	136,820	51,694	" 25	161,263	4,246	21,492	31,009	218,010
18,018	12,181	128,848	55,824	Mar. 4	155,413	6,138	24,187	29,135	214,871
18,028	20,689	117,625	52,082	" 11	151,023	4,168	23,514	27,019	208,724
18,042	12,614	136,943	49,301	" 18	162,811	4,532	23,261	26,394	216,800
18,058	9,271	156,824	51,857	" 25	182,428	6,138	22,374	25,670	235,510
18,074	20,655	116,273	51,180	Apr. 1	153,078	8,071	23,272	21,758	206,182
17,647	8,994	135,096	55,555	" 8	172,463	6,147	22,040	16,642	217,292
17,666	8,770	127,883	51,228	" 15	102,833	7,456	22,214	13,544	205,547
17,679	7,352	128,668	50,963	" 22	110,093	8,581	22,376	63,632	204,682
17,698	13,960	122,627	51,369	" 29	111,233	7,513	27,143	59,765	205,654
17,721	16,802	118,454	49,627	May 6	117,358	7,499	23,639	54,108	202,604
17,738	12,568	128,550	50,469	" 13	127,843	6,965	21,447	51,070	207,325
17,754	17,563	125,801	47,298	" 20	130,418	6,718	22,415	48,838	208,417
17,773	7,606	140,635	47,836	" 27	149,398	6,594	20,468	42,770	219,850
17,790	16,030	123,732	46,424	June 3	137,098	6,648	21,614	38,616	203,976
17,799	8,976	131,052	46,701	" 10	140,198	6,429	21,074	37,761	204,468
17,819	11,873	133,135	47,255	" 17	144,518	6,487	21,703	38,875	210,083
17,835	8,022	133,588	47,320	" 24	145,188	6,512	20,617	35,607	206,744
17,850	11,505	171,557	49,261	July 1	187,733	6,004	26,425	29,954	256,176
17,867	10,370	146,488	47,916	" 8	171,058	6,637	21,738	24,178	222,611
17,886	9,066	120,751	47,461	" 15	150,018	6,293	20,908	18,945	195,164
17,900	13,912	127,840	49,919	" 22	166,308	6,922	21,199	16,242	209,571
17,919	8,721	136,862	47,780	" 29	118,925	7,110	29,952	57,289	211,282
17,910	23,274	118,138	47,911	Aug. 5	130,925	7,043	20,196	48,199	207,263
17,957	19,615	120,073	46,619	" 12	136,010	7,446	19,662	47,146	210,294
17,980	8,236	141,987	47,111	" 19	140,050	6,913	20,550	51,134	218,647
18,001	7,261	145,978	46,750	" 26	139,723	6,710	18,692	52,869	217,993
18,016	15,099	131,288	46,742	Sept. 2	131,262	7,245	21,294	51,844	211,145
18,036	8,420	129,838	46,556	" 9	136,732	5,088	21,134	49,896	212,850
18,051	8,143	137,983	47,596	" 16	138,012	3,989	21,305	50,272	211,578
18,070	11,807	134,712	46,873	" 23	134,797	4,147	22,870	49,649	211,463
18,094	10,264	135,710	51,510	" 30	140,887	2,366	28,759	43,587	215,578
17,667	5,770	138,214	50,193	Oct. 7	118,437	3,384	21,748	38,305	211,874
17,674	8,159	135,306	52,002	" 14	151,777	2,436	20,691	35,237	213,141
17,680	7,249	138,732	51,914	" 21	158,222	2,572	20,245	31,536	215,575
17,699	3,756	141,100	48,902	" 28	151,223	2,470	27,229	30,426	211,457
17,713	21,647	118,948	47,859	Nov. 4	158,123	2,779	21,708	23,557	206,167
17,734	7,163	142,923	48,627	" 11	174,198	2,508	21,300	18,450	216,456
17,751	8,178	145,721	46,483	" 18	177,308	3,330	21,207	16,888	218,133
17,761	7,730	148,793	46,311	" 25	187,993	2,694	18,561	11,847	220,595
17,792	7,257	134,974	46,159	Dec. 2	108,588	3,835	20,162	73,597	206,182
17,809	5,409	146,026	46,555	" 9	130,983	3,307	19,731	61,378	215,399
17,829	6,989	146,903	47,555	" 16	152,298	4,011	19,972	42,995	218,276
17,844	6,079	145,361	47,982	" 23	160,813	3,487	20,379	30,580	215,259
17,862	9,070	223,402	48,221	" 30	342,173	3,481	25,758	27,983	299,095



## REVENUE OF THE UNITED KINGDOM

*Net Produce in Quarters of 1942, and in Financial Years ended  
March 31, 1941-42, 1940-41, 1939-40, 1938-39*

(000's omitted.)

QUARTERS, ended	March 31, 1942	June 30, 1942	Sept. 30, 1942	Dec. 31, 1942	Total for calendar year 1942
Customs ... ..	£ 107,088	£ 110,689	£ 117,578	£ 115,162	£ 450,527
Excise ... ..	83,250	83,300	111,500	112,300	400,350
Stamps and Estate etc. Duties ...	29,386	28,235	26,231	25,873	109,725
Other Inland Revenue Duties ...	625	200	60	60	945
Post Office (incl. wireless licences) ...	27,950	29,540	30,980	31,720	120,190
National Defence Contribution ..	6,549	6,185	7,350	6,950	27,034
Excess Profits Tax ...	67,589	56,596	97,952	98,182	320,319
	322,447	321,715	390,651	390,517	1,425,330
Income Tax and Surtax ... ..	493,952	136,528	119,710	112,511	922,701
	816,399	458,243	510,361	503,028	2,351,029
Motor Vehicle Duties ... ..	25,592	3,145	1,506	1,816	32,059
Canadian Government Contribution ... ..	—	98,074	56,742	69,904	224,720
Crown Lands ... ..	240	250	210	260	960
Interest on Sundry Loans ... ..	2,276	633	392	1,427	4,728
Miscellaneous Receipts ... ..	31,665	16,630	36,426	23,849	108,570
	876,172	680,010	635,640	630,347	2,722,169

YEARS, ended March 31,	1941-42	1940-41	1941-42 (compared with 1940-41)		Corresponding years	
			Increase	Decrease	1939-40	1938-39
Customs ... ..	£ 378,361	£ 301,939	£ 76,422	—	£ 362,136	£ 226,326
Excise ... ..	325,650	224,100	101,550	—	137,900	114,200
Stamps and Estate etc. Duties ...	105,008	91,455	10,548	—	91,790	98,110
Other Inland Revenue Duties ...	902	1,015	—	113	1,300	1,550
Post Office (incl. wireless licences) ...	111,250	101,710	12,540	—	88,657	89,850
National Defence Contribution ...	21,883	21,085	—	2,202	26,910	21,890
Excess Profits Tax ... ..	217,160	72,103	175,057	—	10	—
	1,163,209	822,137	373,087	2,315	611,763	552,226
Income Tax and Super Tax ... ..	811,594	600,056	211,538	—	459,463	398,131
	2,037,803	1,122,493	617,625	2,315	1,071,626	950,657
Motor Vehicle Duties ... ..	38,422	34,006	416	—	31,086	35,608
Crown Lands ... ..	950	1,100	—	150	1,250	1,330
Interest on Sundry Loans ... ..	5,231	2,553	2,681	—	4,916	5,699
Miscellaneous Receipts ... ..	92,230	31,132	61,098	—	20,361	12,911
Total ... ..	2,174,639	1,195,284	681,820	2,165	1,132,212	1,006,235
			NET INCR. 679,355			

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1943.

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# JOURNAL OF THE ROYAL STATISTICAL SOCIETY

## PART II, 1943

### OSCILLATORY MOVEMENTS IN ENGLISH AGRICULTURE

By M. G. KENDALL

#### INTRODUCTION

1. It has long been known that the annual output and prices of agricultural products in this and other countries fluctuate in a more or less regular manner. The object of the work discussed in the present paper was to ascertain whether the English fluctuations could be described in any sense as "cycles" and what were their main features. I began as a sceptic, for there can be little doubt that agriculturists in the past have assumed the existence of agricultural cycles much too uncritically; but the evidence shows, I think, that in a certain sense there do exist systematic oscillatory effects for many of the major English crops and livestock populations. These oscillations are not "cycles" in the strict sense of the word; that is to say, their peaks and troughs do not recur at regular intervals, and they do not seem to be capable of being represented with any reality by periodic functions of the time. They can, however, be described in terms of mathematical models, and I believe the theory employed herein (based mainly on the work of Udny Yule) has a general application to the study of economic fluctuations.

#### THE DATA

2. The material used was taken from the Agricultural Returns for England and Wales, and in most cases an annual series was obtained running back to 1867, the first year in which figures were systematically collected by the Government for the whole country. To eliminate the seasonal effect I took figures which are either collected at a fixed time in each year (such as acreages, populations and yields per acre) or are an average over the year (such as prices). Fifteen series were obtained as follows:—

Product				Nature of series	Extent (both end years included)
Wheat	...	...	...	Yield per acre	1884-1939 (56 years)
"	...	...	...	Acreage	1867-1939 (73 years)
"	...	...	...	Price	1867-1938 (72 years)
Barley	...	...	...	Yield per acre	1884-1939 (56 years)
"	...	...	...	Acreage	1867-1939 (73 years)
"	...	...	...	Price	1867-1938 (72 years)
Oats	...	...	...	Yield per acre	1884-1939 (56 years)
"	...	...	...	Acreage	1867-1939 (73 years)
"	...	...	...	Price	1867-1938 (72 years)
Potatoes	...	...	...	Yield per acre	1884-1939 (56 years)
"	...	...	...	Acreage	1867-1939 (73 years)
Pigs	...	...	...	Numbers	1867-1939 (73 years)
Cows	...	...	...	Numbers	1867-1939 (73 years)
Sheep	...	...	...	Numbers	1867-1939 (73 years)
Horses	...	...	...	Numbers	1870-1938 (69 years)

3. The series of prices for cereals stops at 1938 because, at the time when this investigation was begun, no figures for 1939 were available; and I have not thought it worth while since to go through the arithmetical labour again for the sake of adding another year. There is no comparable price series of similar length for potatoes. For livestock there is no current official price series going back before 1905. It is little short of extraordinary that in a pastoral country like ours no price series reaching back into the nineteenth century should exist for dairy cows, fat or store cattle and fat or store sheep. My efforts to compile such a series were a failure.\*

4. Since all fifteen series cover the period 1914–18, it was necessary to consider whether the four years of World War I should be excluded. The rejection of observations is never entirely satisfactory, and an examination of other parts of the series indicates, in my opinion, that in these cases it would not be legitimate. For example, the rise of the wheat acreage from 1·807 million acres in 1914 to 2·557 millions in 1918 was very little greater in absolute magnitude than the fall from 3·509 in 1874 to 2·918 in 1876, and less than the fall from 2·158 millions in 1892 to 1·384 millions in 1895. The disturbance of war is, on the face of it, no greater than disturbances during peace; nor can one assume that it is essentially different in economic nature.

Much the same considerations apply to yields and livestock numbers; but the position is not quite the same for wheat prices, which doubled themselves from 1914 to 1917. It might, perhaps, have been better to work with logarithms of price instead of the prices themselves, though I am not by any means sure that this would solve the difficulty. On the whole I felt that it was better to conform to the practice adopted for the acreages, yields and livestock numbers; and accordingly no part of the series was rejected.

#### THE ELIMINATION OF TREND

5. In practice there are relatively few alternative methods of eliminating trend; one can fit a polynomial to the series or one can take a moving average. A glance at Fig. 1, which shows the course of the wheat acreage over the period concerned, indicates that a polynomial would hardly give a satisfactory trend line unless it were of rather high order and somewhat unstable. I therefore decided to use moving averages, and the question arose as to what were the most suitable extents and weights to adopt. This question has been discussed in a previous note (1939), wherein it was shown that for a study of oscillatory movements it is desirable to use a moving average whose weights are as near equality as possible, and whose extent is as great as possible and a multiple of any periods suspected to exist. In this way we minimize the risk of inducing spurious oscillations into the data or of distorting genuine cyclical effects. On the other hand, a moving average of extent  $k$  sacrifices about  $\frac{1}{2}k$  terms at each

\* A single example will illustrate the difficulties. In the preamble to the *Agricultural Statistics* for 1905, the year in which the current series of store cattle prices was begun, it is stated that "in the absence of official statistics for earlier years the yearly averages struck by the Teviotdale Farmers' Club and Border Agricultural Society are also given so as to form some basis of comparison, notwithstanding the limited district from which data was [sic] drawn." The Teviotdale figures continue to 1912, so there is a period of eight years' overlap with the current official series. Any hopes of splicing the two series are dashed by a comparison between them for these years. Not only are figures in the same year different (which could be corrected for) but in three cases out of seven the Ministry's figures for yearlings show an increase or decrease from one year to the next where the Teviotdale figures show the opposite.

end of the series, and for short series the loss is appreciable. A decision in particular cases has to effect a compromise between theoretical desiderata and practical necessities. For series of 73 terms I was unwilling to sacrifice more than 10 terms; the extent of the average was then indicated as 9 or 11, an odd number being desirable for practical reasons. I finally chose the 9-year average and applied it to all the series.

Fig. 1 shows the wheat acreage and the trend line calculated by a flat 9-year moving average—that is to say, a trend line the value of which at any point is the arithmetic mean of the nine values centred at that point. So far as the

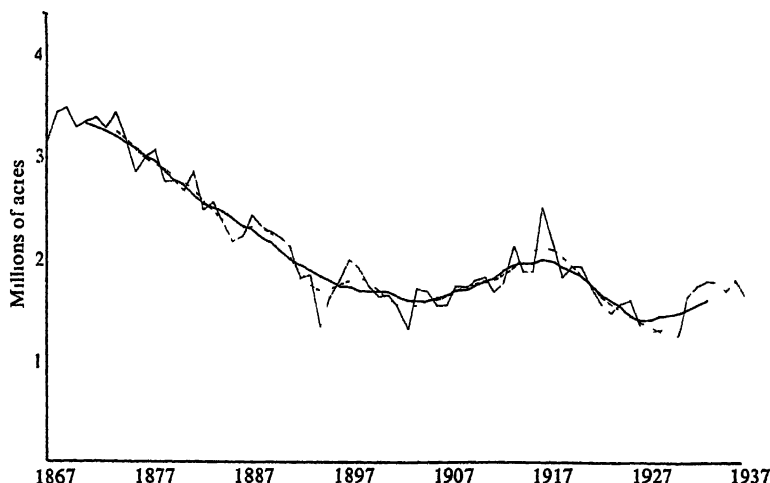


FIG. 1.

Wheat acreage, 1867–1939 (thin line), with nine-year moving average (thick line) and a Spencer 15-point smoothing (broken line).

eye can judge, the line is reasonably good. I have also shown the result of fitting a trend line by Spencer's 15-point formula (1907), which is equivalent to a moving average with weights

$$\frac{1}{10} (-3, -6, -5, 3, 21, 40, 67, 74, 67, 40 \dots \text{etc.}).$$

This smoothing, one of several formulae reproducing a parabolic curve more closely than an ordinary flat average, is evidently too good. It reproduces in the trend line movements which are obviously oscillations in any ordinary meaning of the word. The flat 9-year average appears to satisfy the requirements of the situation as well as can be expected for the crop acreages and livestock numbers.

6. When we come to prices there is another possible way of eliminating trend, namely, by dividing the prices by some factor proportional to the current value of money such as the wholesale price index. On the general merits of this technique I will express no views except to remark that the people who use it rarely seem to attach importance to the spurious correlations which can arise between indices compiled even from uncorrelated variables. For work in connection with agricultural time series it seems to me less satisfactory than the method of moving averages, which will eliminate slow movements both in

the value of money and in the price of the commodity concerned relative to the general price level. In any case, when considering the effect of price changes on the farmer's production policy the relevant corrective factor would be, not the general price level, but the average price of those commodities which the farmer buys—a very different thing.\* For these reasons I eliminated trend in the price data by the usual flat 9-year moving average.

7. The values obtained in the fifteen series by eliminating trend with a 9-year moving average are shown in Tables I and II. They form the data on which the main part of this study is based. For the four crop acreages and the numbers of cows, sheep and pigs the series run for 65 years. That for horses is 3 years shorter, owing to deficiencies in the earlier censuses. Those for the three cereal prices run for 64 years, and those for yields only 48 years. The four yield series are not as long as one could wish, but their value is enhanced by a comparison with the longer series of prices and acreages.

8. It is much easier to go through the arithmetic motions of eliminating trend than to understand exactly what the process means in economic terms. Most of us, I suppose, feel about trend what St. Austin felt about time: "si nemo ex me quaerat quid sit tempus, scio: si quaerenti explicare velim, nescio." Generally, one thinks of oscillation about trend in time series as one thinks of small perturbations in planetary orbits or the body vibrations of a motor-car travelling along a road—temporary disturbances which may be considered apart from the main motion of the system. Fundamentally the assumption appears to be that the oscillations are independent of particular trend values. But there is an opposite point of view (expressed, for example, at great length by Schumpeter, 1939), in which economic progress is regarded as made up of continual disturbances from within, so that oscillation and trend are part of the same phenomenon, and presumably cannot be separately considered. I do not know how the adherents to this theory analyse economic time series, or whether they regard its validity as decidable by quantitative investigation. For the present I have assumed that the elimination of trend is a legitimate process, at least as an approximation. Anyone who disagrees may fairly argue that the resulting analysis, though providing a mathematical model of observed phenomena, brings us no nearer to an economic explanation than an analysis of planetary movements into the Ptolemaic epicycles brought the ancients to the theory of gravitation. This is not a criticism I can refute, but the model of economic oscillations which I shall use can explain a great many of the observed phenomena in a quantitative way. Until the alternative theories can do the same I shall continue to adhere to it.

#### THE MAGNITUDE OF THE OSCILLATORY MOVEMENTS

9. It is useful in the first instance to form some general idea of the relative magnitudes of the oscillations in the fifteen different series. For this purpose the standard deviation is probably the best measure, but to compare series among themselves it is desirable to have some absolute measure such as the coefficient of variation. The mean of a trend-free series, however, is in the neighbourhood of zero, and the coefficient of variation of such a series is

\* The chief items in the farmer's expenditure are labour, rent and foodstuffs, none of which enters into the wholesale index and none of which follows that index at all closely. The three together account for more than half the expenditure on the average farm.

clearly an inappropriate measure. I used a coefficient consisting of the standard deviation of the oscillatory series divided by the median of the *trend* values

TABLE I

*Residual series, after elimination of trend, for the products and prices specified*

Year	Wheat (1,000 acres)	Barley (1,000 acres)	Oats (1,000 acres)	Pota- toes (1,000 acres)	Pigs (10,000 head)	Sheep (10,000 head)	Horses (1,000 head)	Cows (1,000 head)	Wheat prices (pence per cwt.)	Barley prices (pence per cwt.)	Oats prices (pence per cwt.)
1871	21	- 57	5	62	4	-176	—	- 69	+ 5	-15	- 1
72	86	- 38	- 8	5	40	-112	—	- 36	+13	- 1	-11
73	42	- 36	- 40	-25	14	50	—	36	+21	+ 0	- 3
74	226	-105	-101	-13	0	111	- 8	66	+ 6	+16	+16
75	20	69	- 24	- 3	-19	60	1	35	-19	- 3	+13
76	-235	79	89	-11	- 8	- 20	15	- 4	-11	-10	+ 4
77	15	- 18	21	-13	20	12	12	- 37	+20	+10	+15
78	121	26	- 56	-19	20	82	20	- 35	- 3	+11	- 1
79	-101	203	-106	3	-20	130	25	10	- 8	+ 2	- 8
80	- 10	52	- 22	- 4	-52	11	8	- 16	- 2	- 4	- 1
81	- 59	47	76	17	-29	-166	9	- 20	+ 6	- 8	- 3
82	220	-118	- 43	- 6	17	-179	- 1	- 58	+11	- 1	+ 1
83	- 53	- 27	62	-12	29	- 81	- 7	- 59	+ 7	+ 3	+ 3
84	46	- 77	- 22	- 7	23	38	- 1	- 7	- 6	+ 2	+ 1
85	- 90	39	-10	- 1	0	97	- 9	103	- 0	0	+ 5
86	-238	73	117	3	-21	8	4	86	- 9	- 8	- 2
87	-126	- 60	105	7	-21	- 5	- 1	53	- 1	- 6	-10
88	146	- 51	- 60	28	- 7	-105	-17	- 61	- 3	- 2	- 9
89	121	- 83	- 86	21	8	- 99	-27	- 95	- 1	+ 2	- 3
90	118	5	-107	-12	34	35	-27	5	+ 3	+ 6	+ 3
91	112	8	-119	- 8	39	159	11	108	+20	+ 7	+10
92	114	- 59	- 31	-17	-38	167	24	107	+ 5	- 1	+ 8
93	-118	- 13	100	- 7	-11	31	17	16	- 6	+ 2	+ 1
94	- 50	27	161	-21	-16	-103	11	- 88	-18	- 0	- 5
95	-608	116	211	8	35	-104	16	- 70	-15	- 0	-12
96	-185	69	- 9	31	40	- 15	23	- 46	- 1	- 1	- 8
97	53	- 6	- 33	-25	-13	- 23	- 1	- 29	+11	+ 1	0
98	279	-122	-133	-17	- 4	17	- 6	22	+17	+ 7	+ 4
99	225	- 20	- 86	- 1	10	71	- 5	93	- 5	+ 3	+ 1
1900	72	22	-10	5	-14	35	-19	29	- 3	0	+ 1
01	- 69	52	- 16	19	-28	16	-10	- 10	- 1	+ 1	+ 4
02	- 40	25	11	11	-17	- 27	-23	- 85	- 2	+ 1	+ 6
03	-127	8	55	- 1	19	- 32	1	- 70	- 3	- 5	- 3
04	-288	33	148	- 1	34	- 49	18	16	+ 1	- 4	- 6
05	125	- 73	- 37	30	- 8	- 61	23	19	- 2	- 3	- 3
06	73	- 19	- 12	- 4	-20	- 52	16	34	- 5	- 2	0
07	- 75	- 22	51	- 18	4	- 24	- 6	19	0	+ 2	+ 1
08	-105	- 33	49	-13	21	68	-25	9	+ 3	+ 2	0
09	16	- 30	- 10	5	-13	141	-22	31	+ 9	0	- 1
10	21	13	3	- 29	-18	119	-33	- 13	- 1	- 9	- 7
11	57	- 37	- 11	- 7	23	66	51	29	- 9	+ 2	- 7
12	10	11	21	25	11	- 52	38	- 28	-11	- 6	- 6
13	-159	118	- 87	- 6	20	-117	31	-125	-32	-29	-27
14	-111	60	-211	- 9	21	- 61	26	60	-33	-41	-28
15	171	-210	-112	-15	23	19	-92	- 1	+ 3	-21	-13
16	- 91	-131	-110	-63	5	128	-13	- 1	+ 7	+12	-11
17	- 97	- 1	25	6	-20	97	2	14	+ 40	+19	+12
18	512	59	525	119	-15	60	12	98	+28	+ 6	+47
19	181	88	301	-10	- 36	- 29	36	58	+27	+99	+56
20	- 93	206	18	30	-25	-174	22	-167	+51	+99	+69
21	51	6	- 81	36	21	-107	62	- 50	+14	-10	-24
22	81	- 31	-22	41	- 3	-112	41	- 61	-37	-56	-34
23	- 11	-17	- 94	-41	17	-109	19	8	-42	-61	-31
24	-147	5	57	-56	66	- 23	8	37	-11	+16	-12
25	-131	67	- 69	-13	3	60	-19	53	+ 9	+ 2	+ 1
26	31	- 57	- 31	8	-39	121	- 7	61	+17	- 3	- 5
27	160	-119	- 88	36	5	94	-11	76	+15	+12	+ 4
28	- 30	58	- 31	7	26	- 25	-13	- 20	+ 5	+ 3	+17
29	-108	56	120	29	-32	- 90	-15	- 63	+10	- 1	+11
30	-121	6	57	-65	-16	- 75	-22	-132	+ 2	-13	-15
31	-290	55	19	-38	-16	72	-17	- 50	-19	- 9	-12
32	-207	12	- 16	25	12	152	-11	- 1	-14	-17	- 2
33	128	-157	- 41	44	- 7	112	- 8	- 45	-21	- 2	-15
34	171	- 22	- 73	17	1	- 64	10	44	-19	+ 2	- 4
35	147	- 78	- 9	-11	10	- 87	-	53	-	-	-



TABLE II

*Residual series, after elimination of trend, for the yields of certain crops*

Year	Wheat, 1/10 cwt.	Barley, 1/10 cwt.	Oats, 1/10 cwt.	Potatoes, 1/10 ton	Year	Wheat, 1/10 cwt.	Barley, 1/10 cwt.	Oats, 1/10 cwt.	Potatoes, 1/10 ton
1888	- 8	- 1	- 3	-6	1912	- 18	-12	-22	-15
89	- 2	- 5	6	2	13	4	5	- 3	3
90	9	11	10	-4	14	10	6	3	2
91	12	7	5	-3	15	3	- 8	5	1
92	-16	8	4	-1	16	-10	0	6	- 2
93	-19	-23	-18	6	17	- 9	- 4	- 5	5
94	5	7	13	-2	18	12	10	12	4
95	-21	- 8	- 7	7	19	-11	- 6	-10	- 4
96	22	2	- 9	3	20	-15	1	- 3	- 3
97	- 7	1	1	-6	21	25	- 4	- 1	- 9
98	20	11	9	2	22	- 4	- 9	-22	11
99	10	8	3	0	23	2	- 4	- 2	- 1
1900	-14	- 7	- 4	-7	24	1	1	4	- 1
01	0	-11	-14	6	25	2	- 4	1	2
02	8	8	14	-3	26	-11	3	11	- 9
03	- 6	- 6	0	-7	27	0	6	1	- 3
04	-25	-10	- 4	2	28	8	13	9	9
05	5	1	-10	0	29	16	17	7	5
06	13	8	8	1	30	-18	-19	- 7	1
07	11	9	17	-7	31	-18	-13	- 8	-10
08	3	- 3	- 1	8	32	- 6	- 3	0	1
09	5	14	5	4	33	15	8	7	2
10	-12	- 4	4	3	34	22	9	2	5
11	10	- 1	- 2	4	35	3	3	2	- 4

(the median being taken in preference to the arithmetic mean merely to save arithmetic). The results are shown in Table III.

TABLE III

*Variability of the series of Tables I and II*

Product	Unit	Standard deviation of series	Approximate median of trend	Col (3) divided by col. (1) $\times 100$
(1)	(2)	(3)	(1)	
Wheat acreage ... ..	1,000 acres	160	1,890	8.5
Barley acreage ... ..	"	75.4	1,630	4.6
Oats acreage ... ..	"	109	2,050	5.3
Potatoes acreage ... ..	"	28.7	430	6.7
Pigs population ... ..	10,000 head	25.0	235	10.6
Sheep population ... ..	"	92.1	1,880	4.9
Horses population ... ..	1,000 head	23.8	1,280	1.9
Cow population ... ..	"	60.3	2,220	2.7
Wheat prices ... ..	pence per cwt.	16.6	103	16.1
Barley prices ... ..	"	22.6	112	20.2
Oats prices ... ..	"	17.4	88	19.8
Wheat yield ... ..	1/10 cwt.	12.53	172	7.3
Barley yield ... ..	"	8.65	157	5.5
Oats yield ... ..	"	8.67	141	6.1
Potatoes yield ... ..	1/10 ton	5.33	61	8.7

10. The most prominent feature of the table is the greater variability shown by the prices of cereals. There can be little doubt that potato prices, if we could obtain a series of comparable length, would exhibit the same effect, for they are notoriously sensitive to over- or under-supply.

There is not much difference between the variabilities of the yields, but on the whole I should expect these figures to understate the true variability. Crop reporters tend to under-estimate high yields and to over-estimate low ones, with the result that the dispersion over a series of years is under-estimated.

Another interesting feature is the differences between coefficients of variability for the livestock populations, that for pigs being 10.6 and that for horses as low as 1.9. This is more or less according to expectation. Horses are mainly used as a source of power on the farm, and one would not expect great fluctuations in their numbers. Cows also are an integral part of many farms. For that matter, so are sheep, and it is interesting to find that the variability of sheep is more than twice that of cows. When we come to pigs we evidently have a reflection of the relative independence of pig-production and soil-farming and of the speed with which the animal can be bred.

The general picture presented by the table conforms to the notion that the variability of the oscillatory series is conditioned by the nature of the productive process. The more the product is integral to the farming system the greater its inertial resistance to change and the smaller its variability.

#### THE SYSTEMATIC CHARACTER OF THE OSCILLATORY MOVEMENTS

11. The most revealing method of investigating systematic effects in oscillatory series known to me is that of calculating the serial correlations of the series. If the values of the series measured about their mean are  $x_1, x_2, \dots, x_N$  we compute the correlations  $r_k$ , where

$$r_k = \frac{\sum_{j=1}^{N-k} x_j x_{j+k}}{\left\{ \sum_{j=1}^{N-k} x_j^2 \sum_{j=1}^{N-k} x_{j+k}^2 \right\}^{1/2}}.$$

The figure obtained by graphing  $r_k$  as ordinate against  $k$  as abscissa is called the correlogram of the series. An account of the theory of this subject is to be found in the books by Wold (1938) and Davis (1941).

If the original series is random the correlogram will exhibit no systematic effect. If it consist of a single harmonic the correlogram reproduces that harmonic. If it is of the type considered below—autoregressive—the correlogram oscillates with diminishing amplitude. The correlogram thus provides a criterion for distinguishing between several types of oscillatory series.

12. For the eleven series comprising the prices, acreages and livestock numbers the first thirty serial correlations were computed, the results being shown in Table IV. For the yields of wheat and potatoes the first twenty coefficients were computed (Table V), the series being too short to make it worth while going further. Since neither of these latter series showed any signs of regularity, I did not bother to calculate the correlations for yields of oats and barley, which evidently follow much the same course as wheat. Figs. 2-5 show the correlograms.

TABLE IV  
*Serial correlations of the series of Table I*

Order of Correlation	Wheat acre-age	Barley acre-age	Oats acre-age	Potatoes acre-age	Pigs	Sheep	Horses	Cows	Wheat prices	Barley prices	Oats prices
1	0.268	0.230	0.157	0.002	0.300	0.395	0.131	0.319	0.577	0.176	0.582
2	-0.153	-0.196	-0.049	-0.290	-0.111	-0.151	-0.156	-0.181	0.025	-0.150	0.112
3	-0.177	-0.253	-0.334	-0.174	-0.297	-0.601	-0.156	-0.500	-0.267	-0.315	-0.217
4	-0.274	-0.203	-0.405	-0.052	-0.056	-0.537	-0.421	-0.132	-0.302	-0.222	-0.521
5	-0.285	-0.135	-0.251	-0.057	-0.100	-0.138	-0.102	-0.115	-0.389	-0.213	-0.156
6	-0.074	0.047	-0.065	0.002	-0.115	0.141	-0.171	0.022	-0.310	-0.289	-0.316
7	0.109	0.025	-0.011	0.115	0.107	0.203	0.021	0.278	-0.171	-0.037	0.088
8	0.236	0.093	0.019	-0.022	0.114	0.118	0.100	0.210	0.166	0.195	0.190
9	0.267	0.020	0.021	0.043	-0.127	-0.006	-0.045	0.030	0.111	0.173	0.213
10	0.067	0.153	0.095	-0.128	-0.133	-0.078	-0.005	-0.005	0.372	0.037	0.155
11	-0.130	0.177	0.207	-0.050	0.023	-0.142	-0.206	-0.139	0.171	-0.016	-0.052
12	-0.107	-0.085	0.060	-0.162	0.317	-0.172	-0.151	-0.010	-0.075	-0.085	-0.016
13	-0.234	-0.377	-0.058	-0.081	0.418	-0.186	-0.060	0.005	-0.302	-0.087	-0.180
14	-0.239	-0.249	0.036	0.059	-0.136	-0.128	-0.062	-0.090	-0.332	-0.066	-0.179
15	-0.057	-0.087	-0.036	0.179	-0.128	0.052	0.139	-0.113	-0.317	-0.055	-0.117
16	0.130	0.167	-0.227	0.210	-0.090	0.276	0.106	-0.095	-0.282	-0.010	-0.008
17	0.161	0.271	0.055	0.115	0.100	0.139	0.122	0.141	-0.019	0.069	0.181
18	0.162	0.374	0.059	-0.090	-0.001	0.293	0.088	0.323	0.200	0.181	0.253
19	0.125	-0.003	-0.190	-0.101	0.034	-0.074	-0.031	0.268	0.300	0.166	0.172
20	0.092	-0.182	-0.334	-0.045	0.234	-0.359	-0.060	0.000	0.343	0.091	0.071
21	0.042	-0.176	-0.274	-0.053	0.097	-0.381	-0.201	-0.306	0.115	0.061	-0.075
22	-0.184	-0.168	-0.069	0.111	-0.365	-0.118	-0.273	-0.137	-0.111	0.019	-0.191
23	-0.253	0.021	0.332	-0.165	-0.211	0.173	-0.295	-0.135	-0.201	-0.103	-0.276
24	-0.037	0.206	0.311	0.039	0.196	0.343	-0.171	0.013	-0.195	-0.257	-0.256
25	-0.067	0.133	0.443	0.062	0.223	0.352	-0.259	0.130	-0.221	-0.318	-0.031
26	-0.139	-0.032	0.140	-0.083	0.114	0.154	0.397	0.322	-0.053	-0.005	0.311
27	0.332	0.033	-0.153	-0.137	-0.070	-0.203	0.411	0.282	0.217	0.216	0.511
28	0.383	0.170	-0.372	-0.260	-0.047	-0.456	0.220	-0.016	0.401	0.327	0.326
29	0.165	-0.041	-0.325	-0.041	-0.057	-0.415	-0.018	-0.292	0.361	0.261	0.016
30	0.047	-0.270	-0.310	0.093	-0.093	-0.184	0.020	-0.351	0.021	0.012	-0.287

13. A number of remarkable facts emerge from these diagrams.

(a) In the first place, there is no perceptible systematic element in the correlogram of yields per acre of potatoes and little in that of wheat unless significance is attached to a fluctuation of about four years in the latter. If any crop cycles exist in the world, England and Wales does not appear to share in them.

(b) The wheat and oats prices show a very definite systematic element, and so does barley, though to a smaller extent. The regularity of the

TABLE V  
*Serial correlations of the yields of wheat and potatoes (Table II)*

Order of correlation	Wheat yields	Potato yields	Order of correlation	Wheat yields	Potato yields
1	-0.099	-0.208	11	0.078	0.128
2	-0.205	-0.204	12	0.160	0.216
3	-0.180	-0.087	13	-0.063	0.130
4	-0.038	-0.109	14	-0.309	-0.158
5	-0.044	+0.146	15	+0.264	0.215
6	-0.091	+0.030	16	+0.124	-0.109
7	+0.145	-0.020	17	-0.157	-0.182
8	+0.119	-0.165	18	-0.128	-0.086
9	-0.084	+0.134	19	+0.064	+0.226
10	-0.045	-0.082	20	+0.168	0.060

price data is greater than that of the acreage and livestock data. It seems to me inconceivable that these oscillations in the price correlograms are due to chance, and thus I conclude that there do exist real systematic fluctuations in the price series.

(c) The acreage correlograms for wheat and oats appear to exhibit real systematic effects, and I think the same is true of barley. There appears to be little or no systematic effect in the potato acreages.

(d) The livestock populations, on the whole, appear to exhibit real systematic effects which are more strongly marked for sheep, pigs and cows than for horses.

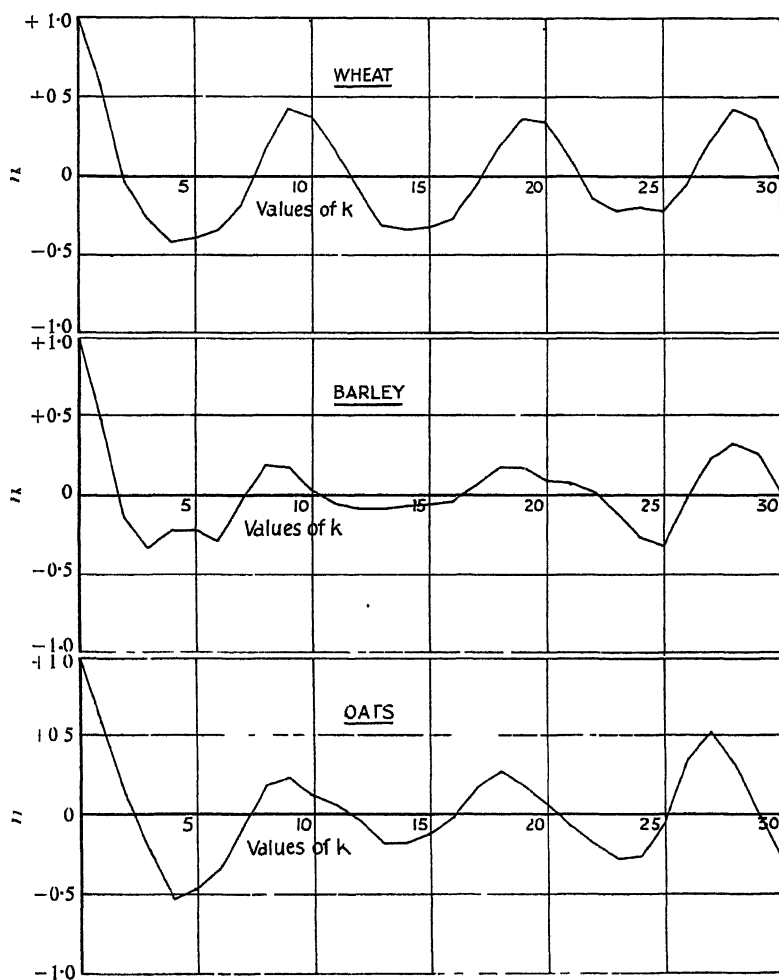


FIG. 2.

Correlograms of prices of wheat, barley and oats.

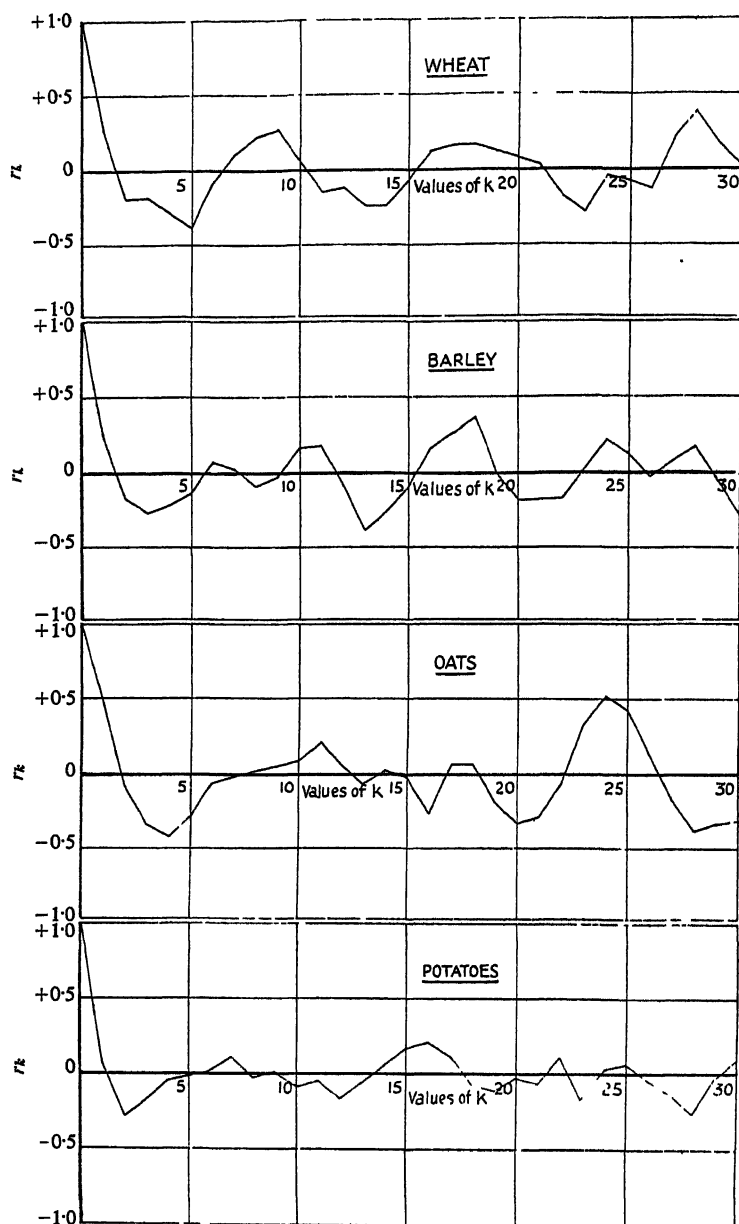


FIG. 3.

Correlograms of acreages of wheat, barley, oats and potatoes.

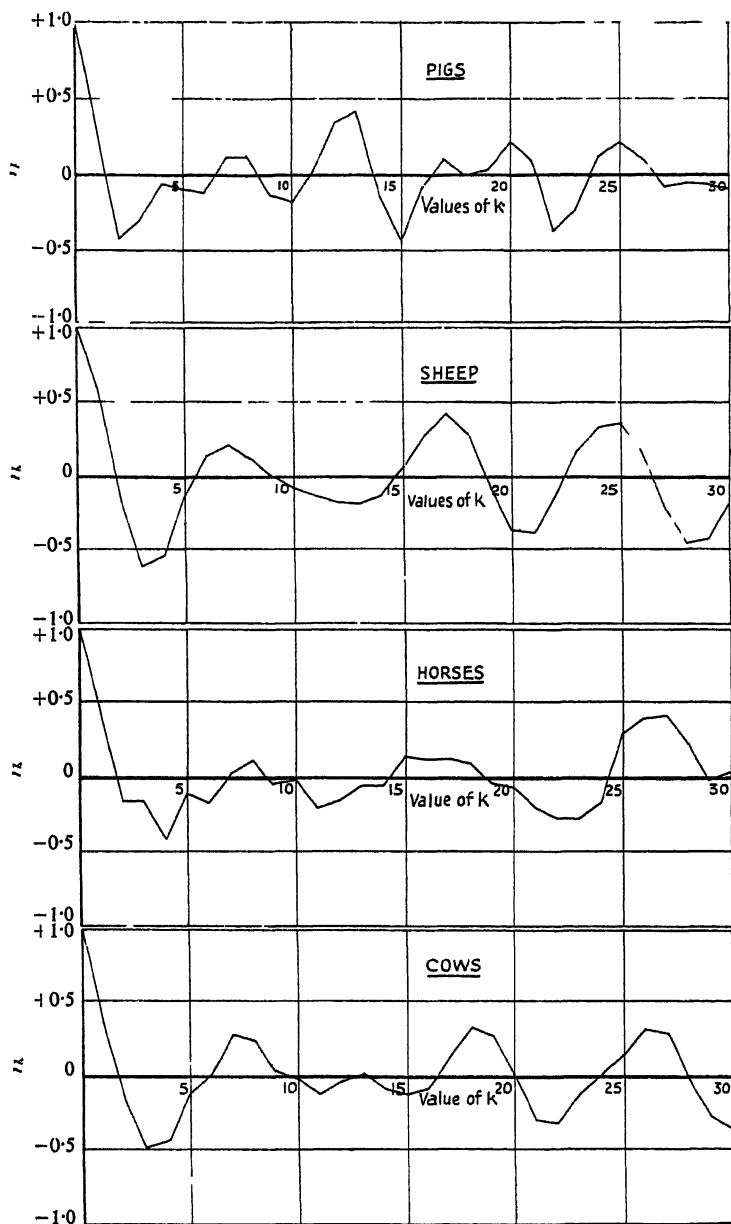


FIG. 4.

Correlograms of population of pigs, sheep, horses and cows.

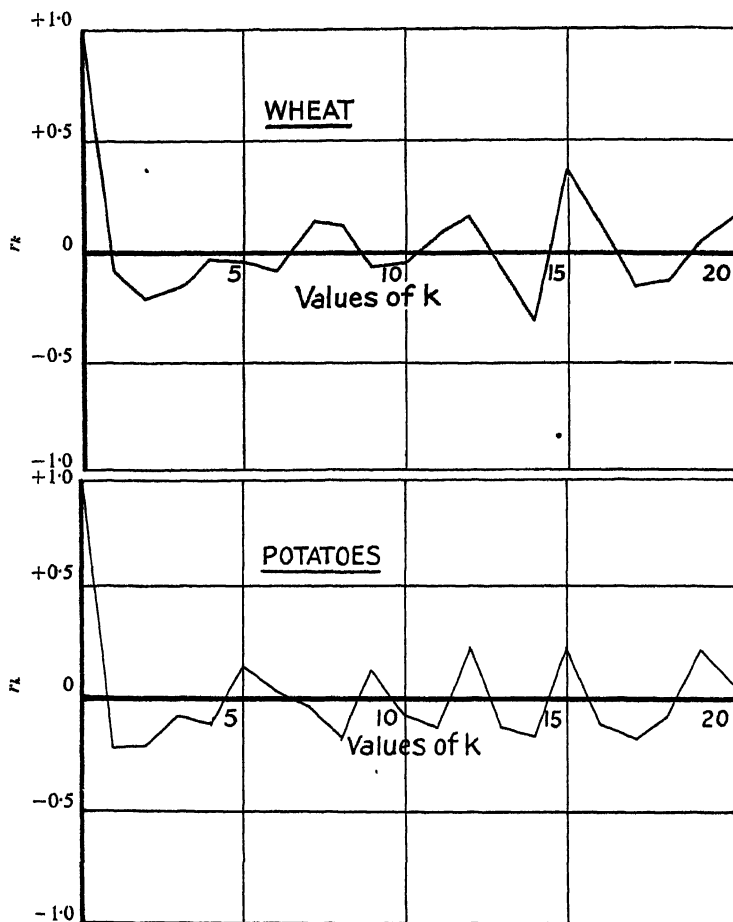


FIG. 5.

Correlograms of yields of wheat and potatoes.

I consider these effects in more detail below. At this point it is sufficient to remark that there do appear systematic effects in the cereal prices, cereal acreages and at least some of the livestock populations, but not in the potato yields and very doubtfully in the cereal yields. In short, we have established that for the majority of the series there does exist something to be explained.

14. Before going on to consider the explanations, however, there is more to be said on the reality of the oscillatory movements exhibited by the correlograms. Owing to the comparative shortness of the series one has to safeguard against being misled by sampling effects and against seeing more in the diagrams than actually exists. No test is known for the significance of a correlogram. For any *given* serial correlation the theory of large samples may be used to show that the standard error is approximately  $1/\sqrt{n}$ , where  $n$  is the number

of pairs entering into the correlation. To test a hypothesis that correlations are zero we should probably not make a serious misjudgment by using the standard error to obtain probabilities in the ordinary way—that is, by reference to the normal distribution; but it is not clear that the number of terms used in calculating these particular coefficients (*e.g.*, for wheat acreage, 64 for  $r_1$ , 63 for  $r_2$  . . . 35 for  $r_{30}$ ) is large enough to justify the use of large-sample theory. However, taking the standard error as  $1/\sqrt{n}$ , we see that, to the 5 per cent. level of probability, a value of 0.25 would be required for  $r_1$  before we could assume its significance, and a value of 0.33 for  $r_{30}$ .

This applies for any given coefficient, but it does not help very much in deciding whether the undulatory character of the whole set of serial correlations is significant of regular oscillation. However, I do not think that anyone would doubt, after looking at the correlograms for cereal prices, cereal acreages and livestock numbers, that the undulations are not accidental.

#### THE ECONOMIC MODEL OF AN OSCILLATORY SERIES

15. The older methods of detecting periodicity in time series were based more or less explicitly on attempts to exhibit the observed variation as (*a*) a systematic element composed of a sum of harmonic terms, (*b*) a superposed random element which was regarded as comparable to errors of observation. It has been found, however, that Fourier analysis and periodogram analysis do not give a satisfactory account of economic series. The schemes to which they give rise do not provide a satisfactory explanation of a typical phenomenon of economic "cycles"—a continual shift in phase and variation in amplitude. Nor is it plausible to suppose that the "errors" in economic series behave like errors of observation in that an aberration at one point of time is independent of subsequent aberrations. In fact an economic disturbance may be "random" in the sense that it is casual and unpredictable; but once it has occurred its effects may endure, and may be incorporated into the future motion of the system.

16. These considerations led Yule (1927) to propose a new method of investigating periodicities. The simple harmonic motion of a system may be represented by the equation

$$\Delta^2 u_t = -\mu u_{t-1} \dots \dots \dots (1)$$

where  $u_t$  is the  $t$ th term of the series and  $\Delta^2$  represents the second difference. Yule introduces a "disturbance function" and writes

$$\Delta^2 u_t + \mu u_{t-1} - \phi(t) = 0 \dots \dots \dots (2)$$

The values of  $\phi$  correspond to disturbances which may, in particular cases, be a random variable. The equation (2) may be written

$$u_{t-2} + (\mu - 2) u_{t-1} + u_t - \phi(t) = 0 \dots \dots \dots (3)$$

and Yule was led to consider the more general equation

$$u_{t+k} + au_{t-1} + bu_t - \phi(t) = 0 \dots \dots \dots (4)$$

The method was applied by Walker (1931) to meteorological data by the use of a still more general form

$$u_{t+k} + a_1 u_{t+k-1} + \dots + a_k u_t - \phi(t) = 0 \dots \dots \dots (5)$$

Yule's method seeks to represent observed series by equations of the form (5). It is assumed that the economic constitution of the system is such that at



any particular time the value of the variate under consideration consists of the sum of two parts: (a) a systematic element determined by a certain number of previous values—the lag of past history, and (b) an outside disturbance. More generally still we may consider the series determined by

$$u_{t+k} = f(u_{t+k-1}, \dots, u_t) + \phi(t) \dots \dots \dots (6)$$

We may call series determined by such equations "autoregressive." They appear to me to offer a plausible and easily understood model of economic oscillations. From the purely descriptive point of view we are not primarily concerned with the reason why values at certain points are related to previous values or where the disturbances come from, though of course both subjects arise for consideration in a discussion of results.

#### AUTOREGRESSIVE SCHEMES FOR THE AGRICULTURAL SERIES

17. It would take too long to discuss each of the fifteen agricultural series in detail. I shall illustrate the general line of inquiry by a particular examination of one series, that of sheep population.

One of the simplest forms of the general equation (6) is

$$u_{t+2} + au_{t+1} + bu_t + c_t = 0 \dots \dots \dots (7)$$

where  $c_t$  is a random variable. In this case the constants  $a$  and  $b$  can be determined from the data by the method of least squares, and in effect we find the regression equation of  $u_{t+2}$  on  $u_{t+1}$  and  $u_t$ . It is, however, necessary to inquire whether equation (7) cannot be improved either by taking account of further linear terms (e.g., the regression of  $u_{t+2}$  on  $u_{t+2}$ ,  $u_{t+1}$  and  $u_t$ ) or by considering curvilinear regressions.

18. The first point can be decided by considering partial correlations. The following shows the partials for sheep population calculated from the actual serial correlations of the data.\*

\* It is assumed in such calculations that  $r_{m+k, n+k, p+k} \dots r_{mn, p}$ , i.e. slight differences due to the shortness of the series are ignored.

Order of partial correlation	Value of partial correlation	Continued product of (1 $r^2$ )
12	0.595	0.6460
13.2	-0.782	0.2509
14.23	0.097	0.2485
15.234	-0.183	0.2402
16.2345	0.031	0.2400
17.23456	0.014	0.2400

The continued product on the right gives the successive values of  $1 - R^2$ , where  $R$  is the multiple correlation coefficient of the dependent variate on the independent variates and measures the closeness of the representation by the regression equation. It is clear that no appreciable gain in representation is to be obtained by taking the regression on more than two preceding terms.

19. The second point—namely, that little is to be gained by considering curvilinear regressions—may be seen from Fig. 6, showing the scatter diagrams of  $u_{t+2}$  on  $u_{t+1}$  and on  $u_t$ . It seems clear enough that the data contain an essential scatter which is unlikely to be removed by curvilinear representation, and I have not thought it worth while to carry out any numerical tests.

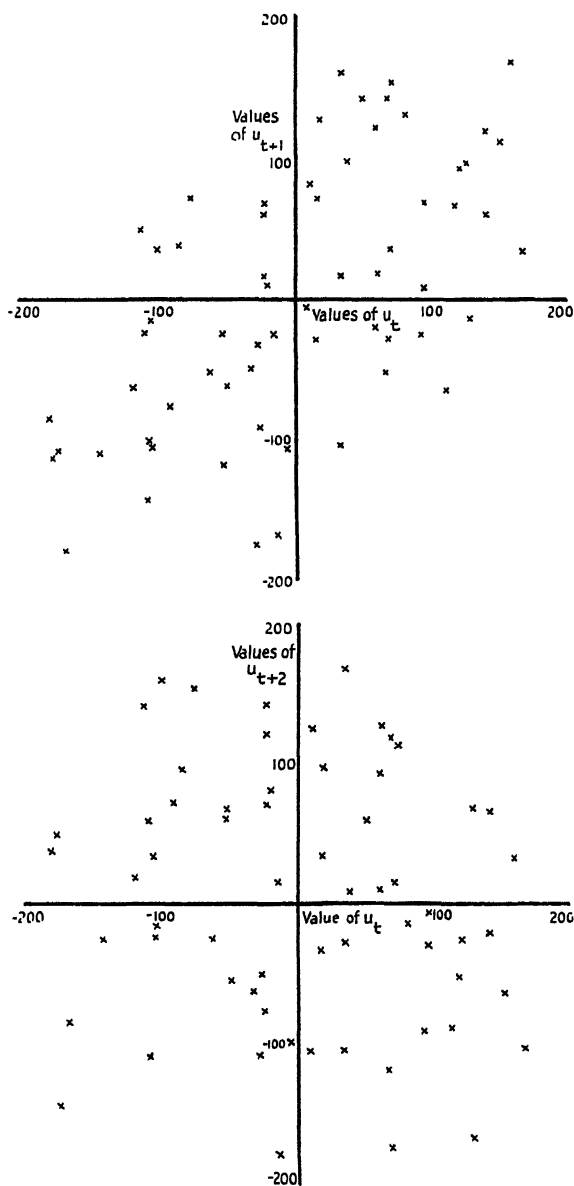


FIG. 6.

Sheep population; scatter diagrams of  $u_t$  on  $u_{t+1}$  (top figure) and  $u_t$  on  $u_{t+2}$  (bottom figure).

20. We may therefore take it that if the data can be represented by an autoregressive scheme with a random disturbance function it is unnecessary to consider any more elaborate scheme than that of equation (7). The properties of this scheme were considered by Yule in the paper under reference, and I have recently dealt with a number of points (thrown up by the present work) mainly connected with the interpretation of results obtained from short series (Kendall, 1943).

The solution of equation (7) may be written :

$$u_t = p' (A \cos \theta t + B \sin \theta t) + \sum_{j=0}^{\infty} \xi_j \varepsilon_{t-j-1} \dots \dots \dots (8)$$

where  $p = +\sqrt{b}$ ,  $\theta = \arctan \sqrt{\left(\frac{4b}{a^2} - 1\right)}$  and  $\xi_t$  is a particular solution of (7) such that  $\xi_0 = 0$ ,  $\xi_1 = 1$ —i.e., such that

$$\xi_t = \frac{2}{\sqrt{(4p^2 - a^2)}} p' \sin \theta t.$$

It is assumed that  $4b > a^2$ . In the contrary case the series increases without limit. It is also assumed that  $p < 1$ . Thus the complementary function in (8) damps out of existence, and if we are dealing with series which were "started up" some time ago, the solution of (7) is effectively

$$u_t = \sum_{j=0}^{\infty} \xi_j \varepsilon_{t-j-1} \dots \dots \dots (9)$$

a moving average of the  $\varepsilon$ 's with harmonic weights. This solution holds whether the  $\varepsilon$ 's are random variables or not—i.e., is generally true for any disturbance function.

If the  $\varepsilon$ 's are random and the series is long enough for cross-product terms  $\Sigma(\varepsilon_t \varepsilon_{t-j})$  to be effectively zero, the autocorrelations of the series are given by

$$p_t = \frac{p'(1 - \frac{2p^2 \cos 2\theta}{(1 + p^2) \sin \theta})}{(1 + p^2) \sin \theta} \sin(k\theta + \psi) \dots \dots \dots (10)$$

where

$$\frac{p' \sin(k\theta + \psi)}{\sin \psi}$$

$$\tan \psi = \frac{1 + p^2}{1 - p^2} \tan \theta.$$

Thus the correlogram represents a damped harmonic, the damping factor being  $p$ .

It seems probable that, unless there is something very peculiar about the disturbances  $\varepsilon$  the system will oscillate with a mean period  $2\pi/\theta$  approximately even when the  $\varepsilon$ 's are not random. The oscillations, as it were, derive from the coefficients  $\xi$ , not the  $\varepsilon$ 's.

21. The correlogram of the sheep data presents an oscillatory appearance, but does not damp out as completely as one would expect from equation (10). It presents, moreover, irregularities which might suggest that more than one period is present in the correlogram. I have shown (1943) that both these effects can be accounted for by the shortness of the series, and have, in fact, given artificial series constructed from random numbers according to formula (7), whose correlogram is very similar to that of the sheep population.

Thus, on the face of it, the sheep data may conform to the autoregressive scheme (7); and so also for the other series considered.

22. The next stage in the work is to ascertain the constants  $a$  and  $b$  of the autoregression equation, and it is here that we begin to run into difficulties. It is easy enough to find the values of  $a$  and  $b$  for the observed series in the ordinary way. In fact, for the sheep data

$$\begin{aligned} r_1 &= 0.595, r_2 = 0.151. \\ \text{Hence } a &= \frac{r_1(1 - r_2)}{1 - r_1^2} = 1.060 \\ b &= \frac{r_2 - a}{1 - r_1^2} = 1 - 0.782. \end{aligned}$$

Thus the autoregression equation is

$$u_{t+2} = 1.060 u_{t+1} - 0.782 u_t + \varepsilon_t \quad (11)$$

For the period 0, however, we find

$$\tan \theta = \sqrt{\left(\frac{4b}{a^2} - 1\right)} = 1.336, \theta = 53.2^\circ$$

giving a period of  $360/53.2 = 6.8$  years.

Now in the correlogram there are peaks \* at  $k = 7, 17$  and  $25$ , giving periods of 10 and 8 years with a mean of 9 years; and there are troughs at  $k = 3, 13, 21$  and  $28$ , giving periods of 10, 8 and 7 with a mean of 8.3 years. We therefore conclude that the real period is between 8 and 9 years, whereas that given by solving the autoregression equation is much shorter.

I find the same effect all through the series considered, and both Yule (1927) and Wold (1938) encountered it. Yule suspected that it was due to *superposed* variation, and I have shown that if a *superposed* random element  $\eta$  is present, the period calculated from the autoregression equation is certain to be shorter than the real period for infinite series, and probably shorter for finite series. We are therefore led to suspect in the sheep data the existence of two elements, the disturbance function which is incorporated into the course of the series and the superposed function which is not; the latter being like an error of observation, affecting the value of the series from time to time but so that the effect on one year does not lag to succeeding years. This is easy to understand, and is agriculturally meaningful; but unfortunately it prevents us from isolating the element  $\varepsilon$  for separate study.

23. The superposed element, in fact, is an unmitigated nuisance, even if it is random. If random, it will reduce every serial correlation in the proportion

$$\frac{\text{var } u}{\text{var } u + \text{var } \eta}$$

and hence alter the estimates of the autoregression constants  $a$  and  $b$ , *not in the same proportion*. It will not affect the periodicity shown in the correlogram, but it will affect the determination of the autoregression equation and the damping factor; and consequently, unless  $\text{var } \eta$  can be found we are unable to determine the equation or to isolate the element  $\varepsilon$  to test its randomness.

In this connection it may be mentioned that the variate-difference method failed to give satisfactory estimates of the superposed variance. For the acreage, price and livestock populations I took differences up to the tenth, and found

\* Owing to the phase angle  $\psi$  in equation (10) the point (0,1) is not to be regarded as a peak of the correlogram. Cf. my 1943 paper.

the root-mean square of the tenth difference-series divided by  $\left(\frac{20}{10}\right)$ . This ought to give an estimate of the random variance of the original series; but in fact the resultant figures were always too small to account for the difference between the observed and predicted fundamental periods of the autoregressive scheme. The point has been discussed in my paper under reference. I suspect that the superposed variation is not random in the sense that values in successive years are independent, but the shortness of the series may have something to do with it.

24. The position may be summed up somewhat on these lines:

Suppose an economic system to be in a state of static or dynamic equilibrium. If small perturbations in the state occur, there will be called into play forces tending to restore the equilibrium condition (for otherwise there would be no stability). These forces will vary according to the extent of the perturbations, and may be regarded as expressing themselves in the fact that the value of the observed variable at time  $t$  can be represented (at least approximately) as a linear function of the values at previous times. The coefficients  $a$  and  $b$  of the autoregression equation are thus expressive of the economic structure of the system.

If the system is subjected to one shock it will oscillate for a time, but in general the oscillation will be damped out fairly rapidly. The continual oscillations we observe in Nature may be accounted for by a continual series of impulses *which may be random*. There may also be present a series of superposed effects which will not affect the vibrations of the system, but do interfere with attempts to estimate the constants of the autoregressive scheme.

This scheme accounts for the variations in amplitude and shifts in phase which are actually observed. From the economic point of view it is, I think, very plausible. Among other things, it implies that there is no such thing as a unique period for oscillatory series. The autoregressive scheme determines a fundamental period, but actual periods (peak to peak, say) of the observed series will vary about this fundamental.\* When we speak of the "period" of an autoregressive system we are referring to the central value of a distribution of periods. This is one of the crucial differences between the autoregressive scheme and the harmonic scheme underlying periodogram analysis.

25. There is one elaboration of the autoregressive scheme which is perhaps worth a reference, although in the present case it led to abortive results. It is natural to wonder whether the scheme

$$u_{t+2} + au_{t+1} + bu_t + c_t = 0$$

may not be too rigid when the series extends over long periods. The coefficients  $a$  and  $b$  represent the economic set-up of the industry considered, and it is quite possible that over 70 years the set-up alters appreciably. In other words,  $a$  and  $b$  may not be constants but may be functions of the time.

Consider then the scheme represented by

$$u_{t+2} + (a_0 + a_1t + a_2t^2)u_{t+1} + (b_0 + b_1t + b_2t^2)u_t + c_t = 0 \quad (12)$$

The coefficients  $a_0$ , etc., may be determined by least squares, so as to minimize

$$\Sigma(u_{t+2} - (a_0 + a_1t + a_2t^2)u_{t+1} - (b_0 + b_1t + b_2t^2)u_t)^2 = 0$$

\* Experimental evidence indicates that the observed periods are distributed approximately normally about a central value. This central value need not necessarily be the fundamental period of the autoregressive scheme, though it is not appreciably different in at least some practical cases. Cf. my 1943 paper.

TABLE VI

*Sheep series with values given by auto-regressive schemes of equations (11) and (13)*

Year	Series	Auto-regression of equation (11)	Deviation	Auto-regression of equation (13)	Deviation
(1)	(2)	(3)	(2) - (3)	(1)	(2) - (1)
1871	-176	—	—	—	—
2	-112	—	—	—	—
3	50	19	31	55	- 5
4	141	141	0	126	15
5	60	110	- 50	73	- 13
6	- 20	- 47	27	- 61	41
7	12	- 68	80	- 63	75
8	82	28	54	26	56
9	130	78	52	63	67
80	- 14	74	- 88	54	- 68
1	-166	-117	- 49	-112	- 54
2	-179	-165	- 14	-167	- 12
3	- 84	- 60	- 24	- 46	- 38
4	38	51	- 13	54	- 16
5	97	106	- 9	101	- 4
6	8	73	- 65	69	- 61
7	- 5	- 67	62	- 65	60
8	-105	- 12	- 93	- 11	- 94
9	- 99	-107	8	-107	8
90	35	- 23	58	- 27	62
1	159	115	44	112	47
2	167	141	26	148	19
3	34	53	- 19	66	- 32
4	-103	- 95	- 8	- 86	- 17
5	-104	-136	32	-141	37
6	- 15	- 30	15	- 42	27
7	- 23	65	- 88	60	- 83
8	17	- 13	30	- 15	32
9	71	36	35	36	35
1900	35	62	- 27	70	- 34
1	16	- 18	34	- 11	27
2	- 27	- 10	- 17	- 7	- 20
3	- 32	- 41	9	- 43	11
4	- 49	- 13	- 36	- 18	- 31
5	- 61	- 27	- 34	- 34	- 27
6	- 52	- 26	- 26	- 36	- 16
7	- 24	- 7	- 17	- 17	- 7
8	68	15	53	10	58
9	141	91	50	97	44
10	119	96	23	116	3
1	66	16	50	37	29
2	- 52	- 23	- 29	- 9	- 43
3	-117	-107	- 10	-108	- 9
4	- 61	- 83	22	- 97	36
5	19	27	- 8	15	4
6	128	68	60	66	62
7	97	121	- 24	131	- 34
8	69	3	66	17	52
9	- 29	- 3	- 26	7	- 36
20	-174	- 85	- 89	- 82	- 92
1	-107	-162	55	-169	62
2	-142	23	-165	10	-152
3	-109	- 67	- 42	- 75	- 34

TABLE VI—*continued.*

Year	Series	Auto-regression of equation (11)	Deviation		Auto-regression of equation (13)	Deviation	
(1)	(2)	(3)	(2)	(3)	(1)	(2)	(3)
1924	- 23	- 4	- 19	- 13	13	10	10
5	60	61	- 1	55	55	5	5
6	121	82	39	78	78	43	43
7	94	81	13	80	80	14	14
8	- 25	5	- 30	7	7	- 32	- 32
9	- 90	- 100	10	- 92	- 92	2	2
30	- 75	- 76	1	- 69	- 69	- 6	- 6
1	72	- 9	81	- 6	- 6	78	78
2	152	135	17	121	121	31	31
3	112	105	7	86	86	26	26
4	- 64	0	- 64	- 11	- 11	- 53	- 53
5	- 87	- 115	68	- 136	- 136	49	49

This leads to six equations such as

$$\Sigma(u_t u_{t-1}) + a_0 \Sigma(u_{t-1}^2) + a_1 \Sigma(tu_{t-1}^2) + a_2 \Sigma(t^2 u_{t-1}^2) + b_0 \Sigma(u_{t-1} u_{t-2}) + b_1 \Sigma(tu_{t-1} u_{t-2}) + b_2 \Sigma(t^2 u_{t-1} u_{t-2}) = 0$$

and five others which I forbear to write down.

For the sheep data I find, after arithmetic which is even more tedious than is customary in such cases,

$$u_{t-2} = (1.171 + \frac{0.199}{100}t - \frac{3.822}{10,000}t^2)u_{t-1} + (-0.730 + \frac{0.097}{100}t - \frac{0.249}{10,000}t^2)u_t \quad (13)$$

Table VI shows the original sheep data and the values given by (11) and (13). The latter is not much of an improvement on the former. For the variances I find, in units of 10,000 head,

Variance of actual series	8474
Variance of the difference of the original and series (11)	2304
Variance of the difference of the original and series (13)	2150

The scheme (11) accounts for about 74 per cent. of the variance of the series, and that of (13) for about 75 per cent.

26. In a way this is rather disappointing. There appears to be an essential scatter in the data which no ordinary polynomial can cope with. On the other hand, when we remember the extraordinary disturbances to which sheep production has been subject in the last 70 years—the wars and depressions, the exhaustion of hill pastures and light wold farms, the impact of frozen mutton and lamb imported from the Southern hemisphere, the change in consumers' tastes from mutton to lamb—it is perhaps surprising that the simple autoregressive scheme works as well as it does. The agricultural economic system is so complex that we must abandon hope of ever representing a time series for a particular product with any exactitude.

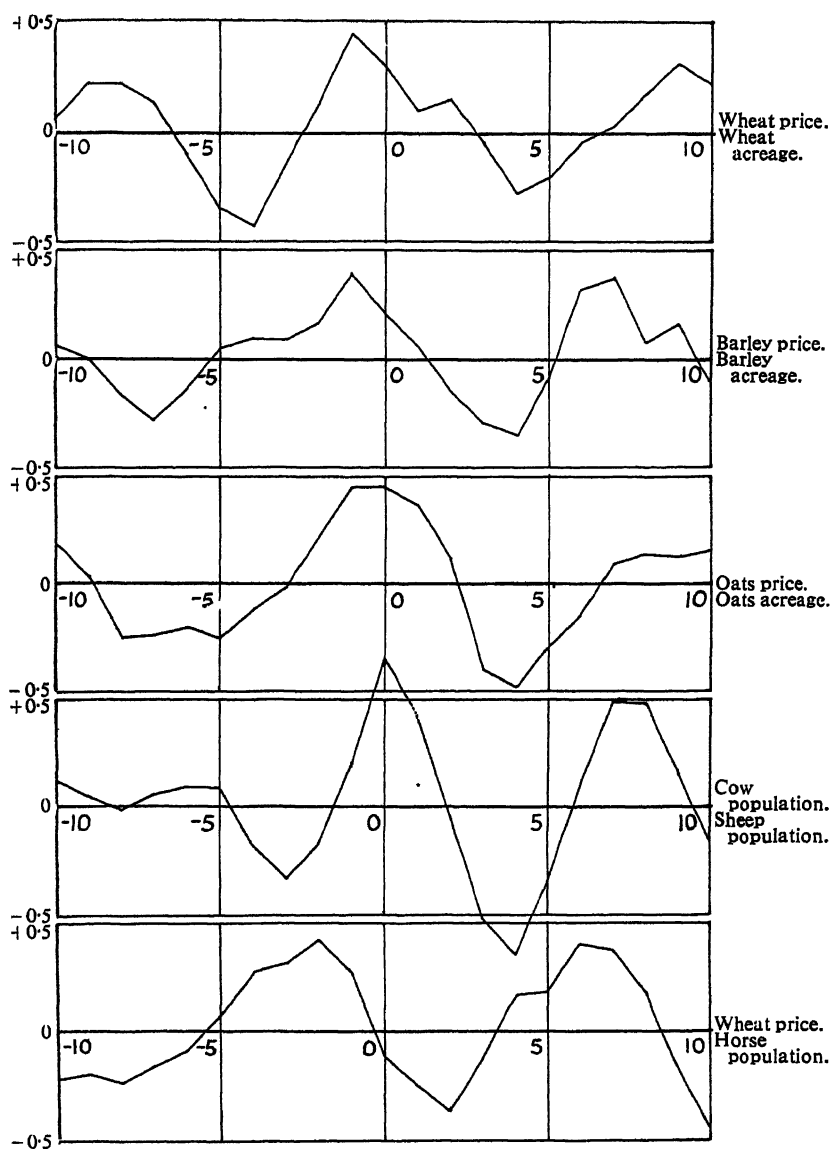


FIG. 7.

Lag correlograms of wheat price and wheat acreage, barley price and barley acreage, oats price and oats acreage, cow population and sheep population and wheat price and horse population.



## INTERACTIONS

27. When a number of products are associated or are likely to be affected together by external shocks there may appear interactions of a very complicated kind. Movements in one series may affect the disturbance functions in others, and in consequence the functions may cease to be random; and even if they continue to be random, the functions for different products may be correlated. Some idea of the interactions of the series may be obtained by a natural generalization of the serial correlations. If the two series, measured about their means, are  $x_1, x_2, \dots, x_N, y_1, y_2, \dots, y_N$ , we may compute the *lag* correlations

$$r_k = \frac{\sum_{j=1}^{N-k} x_j y_{j+k}}{\left\{ \sum_{j=1}^{N-k} x_j^2 \sum_{j=1}^{N-k} y_{j+k}^2 \right\}^{\frac{1}{2}}}$$

and graph  $r_k$  against  $k$  to obtain a *lag* correlogram of the two series. In such a case  $r_{-k}$  is not equal to  $r_k$ , whereas for serial correlations the two are equal within sampling limits.

For fifteen series there are  $\binom{15}{2} = 105$  lag correlograms, and it would be beyond my capacity to compute them all. Even when we exclude the four yield series which, being unsystematic, can hardly give any useful results, there remains fifty-five correlograms. I have computed only five, which are shown in Fig. 7. The lag correlations themselves are given in Table VII.

TABLE VII

*Approximate lag correlations for the series specified*

(Order of correlation is the number of years by which second mentioned product lags behind the first, e.g., correlation of order 10 is that of wheat prices with wheat acreages of ten years earlier.)

Lag correlations.

Order of correlation	Wheat price and wheat acreage	Barley price and barley acreage	Oat price and oat acreage	Cow population and sheep population	Wheat prices and horse population
-10	0.06	0.05	0.18	0.12	- 0.22
- 9	0.22	0.00	0.03	0.04	- 0.19
- 8	0.21	-0.16	-0.24	0.01	- 0.24
- 7	0.13	-0.26	-0.22	0.05	- 0.16
- 6	-0.10	-0.13	-0.20	0.08	- 0.09
- 5	-0.33	0.04	-0.25	0.07	0.07
- 4	-0.41	0.08	-0.12	-0.16	0.27
- 3	-0.14	0.07	-0.02	-0.32	0.31
- 2	0.13	0.16	0.21	-0.18	0.41
- 1	0.44	0.38	0.44	0.19	0.25
0	0.30	0.20	0.44	0.65	- 0.12
1	0.10	0.05	0.35	0.42	-0.24
2	0.15	-0.14	0.11	- 0.05	-0.36
3	-0.04	-0.28	-0.40	-0.51	-0.12
4	-0.28	-0.34	-0.48	-0.66	0.16
5	-0.20	-0.10	-0.30	-0.34	0.17
6	-0.03	0.31	-0.15	0.08	0.39
7	0.03	0.36	0.08	0.49	0.36
8	0.19	0.06	0.13	0.48	0.15
9	0.30	0.15	0.12	0.15	-0.16
10	0.22	-0.10	0.14	-0.15	0.44

These correlations are approximate in two respects: (a) it was assumed that as the means of the series are near zero the mean product-moment of the observations is an adequate approximation to their covariance; (b) the estimated covariances were divided by the square root of the product of the root-mean squares of the whole series in arriving at the correlations. From one or two trials I do not think these approximations will make a difference of more than a unit or two in the second place of decimals.

28. The five lag correlograms show the interaction of (1) wheat prices and wheat acreage, (2) barley prices and barley acreage, (3) oats price and oats acreage, (4) sheep and cow populations and (5) wheat prices and horse populations. All five present an unmistakable systematic appearance, and we must conclude that interactions do exist. It is even possible, on certain assumptions, to predict the form which the lag correlograms should take for autoregressive series.

Suppose, in fact, that we have two series of the autoregressive type (7) with solutions of type (11), namely

$$u_t = \sum_{j=0}^{\infty} \xi_j c_{t-j-1} \\ v_t = \sum_{j=0}^{\infty} \chi_j \zeta_{t-j-1} \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

we then have:

$$\text{cov}(u_t, v_{t-k}) = \sum_{i=-\infty}^{\infty} \left( \sum_{j=0}^{\infty} \xi_j c_{i-j-1} \right) \left( \sum_{l=0}^{\infty} \chi_l \zeta_{i-k-l-1} \right).$$

Now let us suppose that the disturbances  $c$  and  $\zeta$  are random, so that  $\text{cov}(\epsilon_r, c_s) = 0$ ,  $\text{cov}(\zeta_r, \zeta_s) = 0$ ,  $r \neq s$ , but that  $c_t = \mu \zeta_t$  where  $\mu$  is a constant. This would correspond to the case where a disturbance external to the system affected both series to a similar extent but in different proportions. We then find:

$$\text{cov}(u, v) = \sum_{j=0}^{\infty} (\xi_j \chi_{j+k}) \mu^2 \text{var} \zeta \quad . \quad . \quad . \quad . \quad . \quad (15)$$

Thus the covariance of the series, and hence the lag correlations, will be proportional to the sum  $\sum (\xi_j \chi_{j+k})$ . If  $\xi, \chi$  are given explicitly by

$$\xi_t = A_1 p_1^t \sin 0_1 t \\ \chi_t = A_2 p_2^t \sin 0_2 t$$

the lag correlation  $p_k$  will be given by

$$p_k \propto p_1^k \sum_{j=0}^{\infty} \{(p_1 p_2)^j \sin 0_1 j \sin 0_2 (j+k)\} \quad . \quad . \quad . \quad (16)$$

The summation, which we need not bother to carry out in full, will result in terms in sines and cosines; and the appearance of the factor  $p_1^k$  implies that  $p_k$  presents a damped sinusoidal appearance for  $k \geq 0$ . If  $k \leq 0$  the effect will be the same except that the damping will be according to the factor  $p_1^{-k}$ , so that the damping is not symmetrical.

29. The five lag correlograms of Fig. 7 appear to be of this general type, but it has to be recognized that the assumptions made in reaching equation (16) as to the disturbances  $c$  and  $\zeta$  was rather specialized, and unlikely to be realized exactly in practice. This analysis is presented accordingly merely to show that the observed lag correlograms accord with the theoretical schemes in a general way. They also indicate the presence of interactions which make it even more difficult to isolate the disturbance functions. From the agricultural

viewpoint we expect such interactions—it would have been incredible had they not appeared; but once again they indicate further complexities in the problem. The deeper one goes into this matter the more one is surprised at the fact that, notwithstanding all the complexities, regular movements continue to appear.

### RESULTS OF THE INQUIRY

#### *Fundamental Periods*

30. The lengths of the fundamental period, as I have indicated above, should be estimated from the correlogram, not by solution of the autoregression equation. From the correlograms given above I estimate the following periods:

	Mean period, peak to peak	Mean period, trough to trough	Average mean period
Wheat acreage ... ..	9.5	9.0	9.3
Barley acreage ... ..	? 5.5	? 5.7	? 5.6
Oats acreage ... ..	? 7.0	? 8.0	? 7.5
Potato acreage ... ..	?	?	?
Wheat price ... ..	9.5	10.0	9.7
Barley price ... ..	10.0	11.0	10.5
Oats price ... ..	9.0	10.0	9.5
Pigs ... ..	4.0	4.2	4.1
Cows * ... ..	8.5	9.5	9.0
Sheep ... ..	9.0	8.3	8.7
Horses ... ..	9.5	9.5	9.5

\* Obtained by disregarding the weak maximum at  $h = 13$ . I think cows follow the same course as sheep and that this maximum is a sampling accident. This conclusion is supported by the lag correlations for cows and sheep discussed in paragraph 38 below.

31. It seems clear that the cereal prices have a fundamental period of about 10 years. Periods for the cereal acreages are not so easy to determine, but in any case they are not so well defined as for the prices. It looks as if the wheat acreage has much the same period as the wheat price, but that barley and oats have shorter periods. There seems to be little or no periodic movement in potato acreages.

Taking into account the fact noted in paragraph 13, that there is little or no regular oscillation in the cereal yields, we may note that the evidence supports the conception that oscillations are due to the economic structure of the system, but not the theory that cycles are generated by cyclical influences from without (such as periodicities in yields caused by sun-spot cycles). The regularity of oscillation is greater for prices, in which the economic structure is more complicated, than for acreages. It seems as if the frictional dissipation of the effects of an impulse operates more for the actual farming system than for the price system, and this is supported by the variability coefficients of Table III. It will, however, be remembered that English cereal prices are linked to world prices, and their oscillations may be conditioned by the oscillations in the world market. This may account for the fact that potatoes, in which we are nearly self-supporting, show less regular oscillations in acreage than the cereals.

The irregularity of the correlograms for barley and oats acreage may be a chance effect, or may be an indication of the dual use of those crops. Barley is used for both brewing and stock feeding, and is, moreover, closely linked to sheep in certain arable systems. Oats are used for both human and animal

feeding, and the acreage movements may be influenced by periods in livestock populations. When we examine the numerous influences at work on the production of these cereals we are, I think, led to the conclusion that the oscillatory movements in production must be due to the perpetual regeneration by irregular hazards, rather than to the free oscillation of a conservative system of forces or a sympathetic oscillation induced by some external rhythmic influence.

32. Why the fundamental period of prices should be 10 years and not, say, 6 or 15, remains a mystery. Comparison with the length of the so-called trade cycle is inevitable. It is extraordinary how this 10-year oscillation keeps on reappearing; but I am not prepared to draw any conclusions from what may be a pure coincidence.

33. The fundamental periods of oscillations in livestock population are moderately well marked, and present some interesting differences. That for pigs is about 4 years, those for cows and for sheep between 8 and 9 and that for horses between 9 and 10. The horse oscillation may be linked with the wheat or the prosperity cycle. It is not surprising to find a short period for pigs, because they are bred more quickly and are less closely associated with the soil than any other form of livestock, except perhaps, poultry. One is also not surprised to find that if periodic movements do exist for livestock their length varies according to the length of the period of production of the finished animal.

It was noted in para. 10 that the sheep and pig populations have a greater coefficient of variability; and it is interesting to observe that on the whole the shorter the period the greater the oscillations in amplitude. This seems to me to harmonize with the conception that the oscillations are due to the structural properties of the system. The slower the vibration the greater the inertia, and the greater the inertia the smaller the disturbance caused by outside shocks.

#### *Damping factors*

34. As pointed out above, the presence of superposed variation distorts estimates of both fundamental period and damping factor from the autoregression equation. It will not, if random, seriously affect the length of period shown by the correlogram; but the combined effect of superposed variation and shortness of series make it difficult to estimate the damping even from the correlogram itself. I have not found any satisfactory way of estimating damping factors under such conditions. For what they are worth, the following are the constants of the autoregression equations calculated from the observed data.

		$-a$	$-b$	$\sqrt{b}$ = damping factor
Wheat acreage ...	...	0.342	-0.275	0.52
Barley acreage ...	...	0.288	-0.252	0.50
Oats acreage ...	...	0.629	-0.377	0.61
Potatoes acreage ...	...	0.081	-0.304	0.54
Pigs ...	...	0.466	-0.554	0.74
Sheep ...	...	1.060	-0.782	0.88
Cows ...	...	0.469	-0.345	0.59
Horses ...	...	0.612	-0.420	0.65
Wheat prices ...	...	0.843	-0.462	0.68
Barley prices ...	...	0.708	-0.487	0.70
Oats prices ...	...	0.755	-0.297	0.54

I do not think one can place much reliance on the individual values. However, they will, if anything, over-estimate the damping factor, and I think we may properly infer that in all cases the oscillations are fairly heavily damped. This is in accordance with expectation.

### *Prediction*

35. It is natural to inquire whether the systematic effects revealed in this enquiry can be made the basis of prediction. On the whole I do not think they can. The autoregression formula may, of course, be used in the customary way; but it is subject to a large margin of error both from the incorporated disturbances and from the superposed variation—some idea of its efficacy as a predictor can be obtained from Table VI. Furthermore, we have to attempt to extrapolate not only for the oscillations, but for the trend of the series as well. The margin of error of the result would, I should think, be so wide that one could predict just as well by an intelligent consideration of all the circumstances and those somewhat arbitrary decisions which are called intuitive. Perhaps a general appreciation of the way in which the oscillations behave might be useful as conditioning these intuitive judgments, but I would not like to claim more.

### *Interaction and lags*

36. From the lag correlations between wheat prices and wheat acreages it appears that there is a considerable positive correlation between the price in one year and the acreage of the following year. Presumably this is a reflection of the fact that a high price in one year leads the farmer to plant more for the following year, in expectation of a continuing benefit. Although farmers appear to be aware in a general way of the existence of cyclical effects, they seem to be rather shortsighted in their production policy.

37. Barley shows a very similar lag correlogram to that of wheat, and again we have a relatively strong positive correlation between the price in one year and the acreage in the next. The lag effect for oats is not so clear. Since we are relatively more self-supporting in oats than in the other two cereals, this may be a reflection of the fact that supply and price in the same year will tend to be more closely related.

38. A correlogram of a somewhat different kind appears for the covariation of sheep and cow populations. The correlations now reach a maximum for  $k = 0$ , which indicates that the oscillations have some cause in common. It may be inferred that the oscillations do not take place one at the expense of the other—that is to say, an increase in cows is not accompanied by a decline in sheep. On the contrary, the two seem, on the average, to react in the same direction. This conforms to the idea that the oscillations in livestock populations are excited by disturbance functions outside the farming system.

The correlations between wheat prices and horses population are also sufficiently regular to indicate a real effect. The maximum positive correlation now occurs between the price of one year and the horse population of two years later.

39. It has always to be remembered that lag correlations can appear without there necessarily being a causal nexus between the two series. They may, in a sense, be nonsense-correlations. If two series are oscillating with mean periods which are close together, and only a comparatively short span of time

is available for examination, then lag correlations of the damped sinusoidal type may very well appear, irrespective of any "real" relationship between the series. The reality of the effect can be determined only by obtaining a longer series.

### Conclusions

40. The results of this enquiry may be summarized as follows:—

(a) The short-term movements in English agricultural time series can be explained as damped oscillations continually regenerated by external impulses.

(b) The various series are inter-correlated, and some at least are probably inter-related.

(c) No systematic effects were detected in the yields per acre of potatoes, and it is very doubtful whether significance can be attached to a small four-year period in cereal yields.

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(d) There are systematic effects in the cereal prices and in acreages and livestock numbers.

(e) Different products have, in general, different mean periods.

(f) Although, from the interactions of the series and the general complexity of the agricultural situation, it is difficult to isolate elements of individual series for separate study, it appears that most of the series can be represented by a simple autoregressive scheme with a disturbance function which may be random and a superposed element which may or may not be random.

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### DISCUSSION ON MR. KENDALL'S PAPER

(received in writing)

MR. UDNY YULE: I am very glad, for more than one reason, that this paper by Mr. Kendall is being published in the *Journal*. It contains an unequalled mass of data on its own specific subject—the labour put into the paper must have been enormous—and the conclusions are of permanent interest, for they concern, not a temporary situation, but the nature of things. Finally, the work serves to exemplify and direct attention to the very important results on the subject of oscillatory series obtained by the author which have been published

in the *Journal* and elsewhere. The misleading figures that may be obtained with short series (§ 14) offer one instance, and the theoretical conclusion that the initial unit correlation for  $k = 0$  is not to be regarded as a maximum of the correlogram (§ 20, footnote) affords another: the latter clears up a difficulty, for the interval from zero to the first minimum of the correlogram seemed apt to give a rather divergent value for the apparent period.

It is naturally gratifying to my vanity to find the scheme suggested in the "sunspot" paper, to which the author refers, finding application and acceptance here, and interesting though not gratifying to find the author meeting with the same difficulties. I wrote at the end of that paper, "Variables affected largely both by disturbances and by superposed fluctuations present a very difficult problem for analysis." I had hoped that abler hands might clear up the problem, but it still blocks the way: as Mr. Kendall forcefully remarks, "the superposed element is an unmitigated nuisance." He has given, however, in the correlogram, a better way of determining the true period than that which I used. Graduating the data, to endeavour to eliminate the superposed element before finding the autoregression equation, is an obviously imperfect method.

With the five cautiously worded conclusions at the end of the paper I am quite in agreement, but there are one or two points on which I am not clear and would like further comment from the author. The first concerns the difficulty found when the author tried to get a direct estimate of the (supposedly random) superposed element by means of the method of differences (§ 23): "the resultant figures were always too small to account for the difference between the observed and predicted fundamental periods of the autoregressive scheme." It is suggested that the superposed variation may not be random. Well, suppose it is not. If it possess such a degree of continuity that the serial correlations (for this superposed element alone) are still high even when  $k$  is 10 or 20, then it seems to me it will (1) tend to be eliminated into the trend, or if not (2) will have very little effect in diluting the correlations of the complete series. If, on the other hand, it has only such limited continuity as would be possessed by a series derived from a random series by summing its terms in, say, overlapping groups of three,  $u_1 + u_2 + u_3$ ,  $u_2 + u_3 + u_4$ , and so on, then I suppose this would give as required the dilution of the correlations of the complete series, while the method of differences would underestimate its variance. Is this the sort of superposed element the author wishes to suggest? It seems to occupy rather a narrow borderland between the random series and the series so continuous that it will eliminate into the trend.

My second point concerns the way in which all these correlograms appear to suggest only one fundamental period. With the sunspot-numbers I found precisely the same thing: the partial serial-correlations ran off to zero almost at once, as with Mr. Kendall's sheep-correlations in § 18, and it seemed impossible to come to any other conclusion than this, that there was only the one period. But other methods lead to quite a different conclusion. Periodogram analysis suggests a number of periods in the sunspot data and a number of periods in Sir William Beveridge's 300-year series of data for wheat-prices, which Mr. Kendall has not used. It is quite true that such periods may have no *physical* existence, but if they have a *mathematical* existence within the limits of the given series of data it seems to me that *any* method of analysis should bring them out. I do not understand why the method of serial correlations does not: is it merely insensitive? A method for detecting a regular simple harmonic period might, of course, fail to detect an oscillation of the same period; but surely the method for detecting oscillations ought to detect the simple harmonic period? In my paper on "nonsense correlations" (*Journal*, 89, 1) I gave an analysis of the Beveridge series by a different application of the method of serial correlations (89, 41 *et seq.*): trend was not eliminated, but the serial correlations were found for the original data and thence values for serial difference-correlations, the differences being taken at intervals of 1 year, 5 years, 6 years, 11 years and 15 years. The analysis might have been made more complete, but it brought out

two periods which seem to be indubitable, one of them about 5-6 years, the other of some 14 years or so, as well as possible longer periods. The 5-6 years period is oddly close to Mr. Kendall's queried figure for the barley acreage (§ 30) 5.5-5.7 years: his period of about 10 years for wheat prices I did not find, but do not remember that I specially looked for it.

DR. SNOW: There is one feature in the results of Mr. Kendall's important and highly interesting investigation which I think is worthy of some thought.

Some of the series he deals with relate to factors which are directly influenced only to a very small extent, if at all, by external circumstances. Others are very considerably influenced by circumstances outside this country. In the former group are the cases of "yield per acre." The yield per acre of a crop grown in this country is not influenced in any way by the circumstances of production, consumption or price of that commodity in the rest of the world. In the latter group are the price series, particularly wheat. The series relating to the numbers of cows falls within the first group, the chief object being the production of milk, which is not influenced greatly by circumstances outside this country.

Dealing with the various series in the sequences in paragraph 13, those in sub-paragraph (a), in which Mr. Kendall concludes that cycles do not exist, that is, in "yields per acre," are entirely in the first group I have mentioned.

The series in Mr. Kendall's paragraph (b) do show "real systematic fluctuations," and these are all in the second group referred to.

In Mr. Kendall's sub-paragraph (c), acreage of wheat is very definitely influenced by external circumstances and falls into my group two above. The acreage of oats and barley probably also fall mainly in group two, though they are not so much influenced by external circumstances as wheat is. In the case of potatoes, where no systematic effect is detected, this item falls under my group one.

So far as the series covered in paragraph 13, (a), (b) and (c) are concerned, therefore, it looks as if we could say that there is a high correlation between the influence of external circumstances and the extent of "real systematic fluctuations."

The series referred to in paragraph (d), namely, the livestock population, do not so clearly, however, follow the rule, though they do to some extent. The fluctuations in the number of livestock in the country is influenced in some measure by external circumstances but not to the same extent as wheat prices or acreage.

This thought suggests that in any further investigations of oscillatory movements, the series might be classified according to the extent to which they are influenced by external circumstances. The case of jute would be of particular interest, as it is an article produced only in one country of the world but the consumption of which is vitally influenced by circumstances in many other countries. Although the foundation for the statement may not be broad enough for generalization, there is definitely a suggestion in Mr. Kendall's results that there is more evidence of cyclical movements in "international" series than in "domestic" series.

MR. J. H. KIRK: Mr. Kendall has once again put everyone in his debt by developing a new technique of research and thoroughly testing it out in spite of the immense amount of arithmetic required. I am quite unqualified, through my ignorance of mathematics, to judge the correctness of this technique, but I might perhaps say that, as applied to agricultural data, it has produced results which on agricultural grounds I should regard as understandable and acceptable.

I find particularly interesting Mr. Kendall's demonstration that time series of the sort he has selected for study have a tendency to diminishing amplitude of



oscillation. Apparently he has assumed (para. 16) that if a series has a systematic element and is liable to outside disturbance, it will display such a tendency to diminution; and in the case of the sheep population series he has tested this assumption, with positive results, by means of "autoregression" analysis. Apparently also, the correlograms display this tendency to diminishing amplitude—though I am not clear why they should—and this is the basis of Mr. Kendall's first conclusion (para. 40) that "short-term movements in English agricultural time series can be explained as damped oscillations continually regenerated by external impulses."

Now if these particular series display such a tendency to diminishing amplitude, we should expect many other economic series to do the same. In point of fact, however, the superficial evidence for diminishing amplitude is remarkably scanty, presumably for the reason that the oscillations are continually regenerated on much the same scale. One usually finds in practice that on the face of the series the amplitude of any completed oscillation is just as likely to be greater than, as it is to be smaller than, that of its predecessor in the series. The only superficial evidence of diminishing amplitude that I can recollect occurs in certain American data which display the presence of 3-4-year cycles: there is in some series displaying this periodicity a tendency for diminishing amplitude of the 3-4-year cycles until at about 9-year intervals there is a "flare up" and the previous amplitude is restored. From this point of view it is of great interest to know that the existence of diminishing amplitude can be analytically demonstrated, though it may not be at all apparent on first inspection.

I should judge that this result might have interesting effects on trade-cycle theory. If I were investigating trade cycles and believed that they had an inherent tendency to constant amplitude, or that the amplitude of each complete oscillation might equally well be either greater or smaller than that of the previous oscillation, I think I should feel I had fairly well explained the phenomena if I could give an account of the conditions determining the amplitude and period of the cycle. I should look for the first partly in the consuming and saving habits of the public, and for the latter partly to the duration of capital goods—that is to say, in both cases to structural elements in the system. If, however, I thought it probable that trade cycles had a tendency to diminishing amplitude unless regenerated, I should look a good deal further, and would want to examine very closely the nature and strength of the regenerating impulse and the reasons for its periodicity.

This is, however, debatable territory, and Mr. Kendall will probably say that at present he is not trying to do much more than look over the fence. I do hope, however, that he will find the opportunity to apply his methods to at least one non-agricultural series, such as wholesale prices or employment, and see if these series too can be made to show the presence of diminishing amplitude. It would be a useful step forward to demonstrate, if it can be demonstrated, that the damping element is not merely a feature of agricultural systems, but is of general prevalence in most types of economic series.

DR. C. OSWALD GEORGE: Mr. Kendall is to be congratulated on presenting a paper of unusual range and originality, and one can only regret that lack of space restricts comments to only a few of its many interesting points. The paper claims special attention on three grounds: the comprehensiveness of its basic data, which tell the broad story of so much of British Agriculture over a long period, the application to these data of new methods of analysis, and the agreements and disagreements of the results thus obtained with those obtained by previous workers in this field.

The basic data, covering a period of 73 years, could hardly be expected to be strictly comparable throughout, but a few points may be mentioned. Agricultural returns were first collected in England and Wales in 1866, in which year

returns were requested from certain owners of livestock and from all persons occupying land to the extent of 5 acres or upwards, but the next year returns were requested from all occupiers of land (except "cottagers or other persons holding small patches of garden ground only, or who may only keep a pig or two"). There followed various restrictions on the inclusion of smaller pieces of land round and about a quarter of an acre or less until 1892, when returns were restricted to holdings over 1 acre, but there were still variations of policy regarding owners of livestock who occupied little or no land. Except for the years 1918-21 and from 1926 onwards, the returns were collected on a voluntary basis, estimates being made when occupiers failed to make returns. In addition to the above changes, there have been various changes in classification and terminology. "Horses," for example, include from 1911 all horses on the holding, but prior to that various classes of horses were excluded. How far these various factors were likely to affect the present analysis it is impossible to state in a brief note, but it may be mentioned that in the past, changes in classification or minimum acreage, and so on, were not always immediately and fully reflected in the returns for the current year, but appeared sometimes to give rise to flutterings for a year or two. It may be added that Mr. Kendall's figures for "cows" apparently relate only to the dairy herd, and do not, as do the other livestock figures, include both sexes and all age-groups, and this may in part explain some of the differences in the relative correlograms.

Some of the results of the analysis, particularly those relating to prices, are not unexpected, but attention will surely be focused on the dictum that "if any crop cycles exist in the world, England and Wales does not appear to share in them." This contrasts strongly with the results obtained by previous workers in this field, and one may wonder if Mr. Kendall's results are really conclusive on this point. First of all, one notices that in his correlogram of wheat yields, the most outstanding and significant figure is that for  $r_{15}$ , and one's mind flies back to Sir William Beveridge's earlier conclusion that "the yield of harvests in Western and Central Europe from the middle of the sixteenth to the opening of the twentieth century has been subject to a periodic influence, or combination of such influences, tending to produce bad harvests at intervals of about 15.3 years, the first epoch falling in 1556. This proposition is about as certain as harmonic analysis can make it" (*J.R.S.S.*, May 1922, p. 412). It is interesting that in this one case the two rival methods have produced even this degree of similarity. Secondly, one wonders, if there is no possibility of errors having crept into the computations, to what extent the rather indefinite form of the wheat yield correlogram is due to the adoption of a nine-year moving average, for examination of the figures suggests that if the original series were smoothed by a more suitable moving average, the resulting correlogram might furnish more definite signs of regular oscillation. This is perhaps also true, though in a less degree, of the pig correlogram, which, with different smoothing of the original series, might also show rather different damping effects.

This brings us to the question of the theoretical basis of the correlograms, which show results that are not strictly comparable throughout their course, since the number of terms correlated may vary substantially; for example, the number of terms in the cow correlations varies from 85 to 46. There may be objections to keeping the number of terms constant (at the lower figure) which would involve sacrificing information, or to adjusting  $r_k$  on the basis of the relative standard error, which is admittedly no measure of the absolute significance of parts of a correlogram yet presumably provides some indication of relative significance. But is there any reason why there should not be shown on every correlogram the standard error band, or, better still, a band equivalent to twice the standard error? When diagrams are drawn on different scales or relate, as do the wheat acreage and wheat yield correlograms, to a different number of terms, such a band would provide at least some indication that various points of the correlograms may not be of equal significance.

There is next the question of the length of the period to be adopted for the

moving average. Mr. Kendall has used a 9-year period throughout, but there is no reason why this period should be equally suitable for all the series studied, and in fact there seems reason to suspect that some of his results may be adversely affected by his choice of a 9-year period. If correlogram analysis is to be of maximum use, it seems desirable to be able at the beginning to determine objectively the ideal period for the moving average, and to exclude the subjective element inevitable in selecting a period which is a multiple of some preconceived cyclical term, seeing that this may seriously affect the final result.

In conclusion, I should like to thank Mr. Kendall once more for the statistical feast he has provided, and can only regret that in times like these it will not get the detailed attention it so clearly deserves.

DR. F. YATES : I should like to express my appreciation of Mr. Kendall's very valuable analysis of the oscillatory movements which affect English agricultural output and prices. It is most satisfactory to see that the oscillatory tendencies which might be expected to exist, having regard to the nature of agricultural production and the method of price determination, can in fact be demonstrated from the examination of actual data.

It would be interesting to see whether it is possible to estimate the periods to be expected in any branch of agriculture from the conditions governing production in that branch; if the expected periods agreed with the observed periods this would give satisfactory confirmation of the basic economic theory. Pig production might be suitable for a first investigation, owing to its comparative independence of other forms of agricultural production.

MR. KENDALL in reply wrote: I am grateful to the contributors to the discussion for the constructive approach which they have all adopted. One of the troubles of analysing time series is that in trying to settle one difficulty one often raises two or three more; and a great deal of further work is necessary to provide satisfactory answers to the various questions which have been put. I will indicate briefly some provisional views, but I hope that before long a further body of evidence will be available to throw more light on this baffling but fascinating subject.

1. Mr. Yule refers to my remark that the variate-difference method does not provide a concordant estimate of random variation. I was puzzled by the apparent failure of the method myself, and am about to embark on some experiments with artificial series to see whether we can get to the root of the trouble. In speaking of superposed variation I was thinking of effects which are not incorporated into the motion of the system by the autoregressive scheme, and are either random or of the type suggested by Mr. Yule, in which serial correlations after the first one or two are effectively zero.

Consider for instance a superposed element for which  $r_1 = 0.1$  and all subsequent serial correlations vanish. For such a series it may be shown that the estimate of variance  $\nu$  provided by the difference-method is related to the actual variance  $\sigma^2$  by

$$\nu = \sigma^2 \left( 1 - \frac{2k}{k+1} r_1 \right)$$

where  $k$  is the order of the difference. For high  $k$  the value of  $\nu$  would thus approximate to only 80 per cent. of the real variance  $\sigma^2$ . Taking into account the possibility of sampling distortions in short series, we can easily see that the variate difference method may give results requiring very careful interpretation if there are traces of correlation in the superposed series. Such correlation will also, of course, appear in the serial correlations of the series obtained when this element is superposed, and the 20 per cent. of variance "disappearing" from

the superposed constituent will be shown as a part of the variance of the systematic component; but only the first serial correlation of the primary series will be affected (except that all are equally diluted by the superposed element), and accordingly the auto-regressive equation will be even more distorted.

2. Mr. Yule also calls attention to the difference between the results given by autocorrelation analysis and harmonic analysis. To be quite sure that this difference exists I have computed the serial correlations of Sir William Beveridge's *trend-free* wheat-price index. (Mr. Yule's correlogram related to the index which included trend.) So far as one can see the only periods which are at all material are those found by Mr. Yule, of 5-6 years and 14-16 years, whereas Sir William attributed significance to several more. The explanation may be that correlogram analysis is insensitive, but I strongly suspect that it is harmonic analysis which is at fault, in that peaks appearing in the periodogram are capable of interpretation as sampling effects without genuine significance. Tests of significance of the periodogram in current use appear to me defective.

3. Dr. Snow's suggestion that there may be more evidence of cyclical movements in international than in domestic series is very interesting, and accords with the general conception of autoregressive movement. Both may be equally subject to disturbances; but it is quite possible that the controls which constitute the economic constraints of the system and ensure the relative smoothness of the oscillation are firmer in the international than in the national sphere. Generally speaking it seems that the more highly organized the market the smoother the oscillation, always excepting the deliberate destruction caused when bulls, bears and other animals in the financial managerie get out of hand.

4. Mr. Kirk suggests that autocorrelation should be applied to other economic series to see if they also behave like damped oscillations continually regenerated. I hope that further inquiries of this kind may be set in train, but some work has already been done. Davis, in his *Analysis of Economic Time Series* (pp. 105 *et seq.*) gives some autocorrelations (not complete series, but enough to support the conclusion that the correlograms are damped) of Industrial Average series, Pig-Iron production, High-Grade Bond yields, Time-Money rates, Bank clearings and various indices of prices. English marriage rates in the nineteenth century exhibit a damped correlogram. Though the series concerned are not economic, it is also interesting that correlograms of temperature and barometric pressure seem to be of the damped type.

5. Dr. George has shaken me a little, but not much, on the question of crop cycles, so I have calculated the correlograms of oats and barley-yields which were taken for granted in para. 12. The results are as follows:

Order of Correlation	Barley	Oats	Order of Correlation	Barley	Oats
1	-0.032	-0.031	11	+0.282	+0.054
2	-0.146	-0.143	12	-0.123	+0.071
3	-0.343	-0.090	13	-0.282	-0.132
4	0.004	-0.079	14	-0.282	-0.359
5	-0.117	-0.056	15	-0.320	-0.210
6	-0.186	-0.418	16	-0.139	-0.034
7	0.190	-0.030	17	-0.102	-0.141
8	-0.235	0.410	18	-0.005	-0.147
9	0.023	0.089	19	-0.351	-0.370
10	-0.049	0.024	20	+0.139	-0.069

The only sign of oscillation I can see here is that of a four-year movement. This itself appears highly doubtful to me, but one has preconceptions which are difficult to ignore, and others may take a different view. At any rate, the comparative smoothness of price and acreage correlograms as compared with those

for crop-yields convinces me that we cannot regard the price and acreage movements purely as sympathetic reflections of yield-variations. This has a bearing on Sir William Beveridge's conclusions quoted by Dr. George, because (apart from my doubts about harmonic analysis) Sir William Beveridge was working with prices, not with yields, and the relation between the two, as evident in my own paper, is not so close as might be assumed.

6. Dr. George is quite right in calling attention to the fact that for short series the serial correlations of high order are based on substantially fewer members than those of low order. The tail of the correlogram is wagged more and more by sampling effects. I would not agree that this is a good reason for sacrificing information and calculating the correlations of lower order from fewer terms; nor am I attracted very much by the idea of standard error bands, because it is the oscillatory character of the whole, not the sampling errors of individual correlations, which are of interest. But I fully agree with the thoughts which prompted Dr. George's comments on this point.

7. As to the effect of trend-elimination on correlograms, the only thing to do seems to be to experiment with some practical series and to see what happens. I should be surprised if the selection of different extents for flat moving averages made any serious difference, and my note referred to at the conclusion of the paper seems to me to provide a convincing negative reply to the question whether the moving average itself generated the pseudo-cyclical movement observed. How far the average may distort the true fluctuations is not so clear, but I hope to be able to proceed with the experimental work in due course.

8. Dr. Yates' suggestion I must leave to the agricultural statistician. It would be most gratifying if some quantitative agreement could be obtained between the observed and predicted constants in an auto-regressive scheme. Kalecki (*Econometrica*, 1935, 3, 327) has had some success in producing a ten-year cycle from theoretical considerations, and perhaps the same could be done for a relatively self-contained system such as pig production. But, as I say, I must leave this to the experts on production.

## MISCELLANEA

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THE LOGICAL AND ANALYTICAL RELATIONSHIP BETWEEN THE THEORY OF  
ACCIDENTS AND FACTOR ANALYSIS

By G. HERDAN

IN the book by E. L. Collis and M. Greenwood, *The Health of the Industrial Worker*, 1921, we find, p. 201, the following passage:

"The most promising line of investigation (*i.e.* of the personal factor in the causation of accidents) is suggested by Spearman and his pupils." Professor Greenwood then mentions the research done by Spearman's pupil, Webb, who has "brought forward evidence of the existence of a second general factor connected with efficiency in what may be . . . called the emotional sphere."

Such an investigation may be conducted in two different ways. It may be our purpose to obtain information as to the *qualitative* nature of the  $\lambda$ 's of the Frequency Theory of Accidents. In this case the most profitable line of research would seem to be to carry out experiments with psychological tests designed so as to determine the quality of the  $\lambda$ 's by means of their correlation, or lack of correlation, with the qualities implied in the artificial tests.

On the other hand, it may be our purpose to obtain information as to the *quantitative* relationship between the  $\lambda$ 's of the Theory of Accidents and the  $g$ 's of Factor Analysis, that is, between the personal factor in the causation of accidents and the "general" or other common factors of factor analysis. In this case we are interested in both the logical and analytical relationship between the two theories. It is only this side of the problem which will be investigated in this paper.

Recent work on this subject was initiated by a purely statistical investigation made by M. Greenwood and G. U. Yule in 1918. A brief account of the work appeared in Rep. 4 of the Industrial Fatigue Research Board, in 1919 (by M. Greenwood and H. M. Woods) and a much fuller account in *Journ. Roy. Stat. Soc.*, 1920 (by M. Greenwood and G. U. Yule).

This latter paper was wholly concerned with the frequency distributions expected to reproduce accident data on various hypotheses as to the *ætiology* of accidents. It is true that in the earlier short note some of the inferences with respect to the correlation of accident scores in different time periods were tentatively explored on a very slender basis of facts, but the providing of really substantial data for this extension was the work of later investigators. For instance that of E. M. Newbold (who also greatly extended and improved the mathematical basis) in *J.R.S.S.*, 1927, and Rep. 34, I.H.R.B., and E. Farmer and E. G. Chambers in Reps. 38, 55, 68 and 84 of the I.H.R.B.

A paper on "Theory and Observation in the Investigation of Accident Causation" by E. G. Chambers and G. Udny Yule with comments by Dr. J. O. Irwin (*Supp. Journ. Roy. Stat. Soc.*, vol. VII, No. 2, 1941) is of special interest for the present discussion because the results reached by Mr. Chambers on certain material are in good conformity with those to which Factor Analysis would lead if applied to the same material.

It is, therefore convenient and historically accurate to speak of Greenwood and Yule's work as a Frequency Theory of Accidents.

By Factor Analysis (shortened to f.-a.) I mean in this paper the Two-Factor Theory by C. Spearman (see *Abilities of Man and their Measurements*, 1932, especially the Appendix where the working formulæ are developed). The later modifications of the theory would need to be considered only in a more detailed account of the relationship between the two theories than is intended here.

(1) In both the Theory of Accidents and Factor Analysis we are concerned with the study of correlation between certain variables, one of which is accessible to direct study, whereas the other is hypothetical and can, therefore, only be estimated. This, as Professor Greenwood observed (*Journ. Roy. Stat. Soc.*, Vol. XC, p. 537), "is the crux of the practical work" which is going on with regard to the Theory of Accidents, but it is also the crux of the work of factor analysis.

If a number of pupils is given a certain combination of psychological tests in order to estimate their individual  $g$ 's ("ability" or "general intelligence"), we achieve this aim by introducing a hypothetical test,  $g$ , whose correlations with the different actual tests is estimated. These correlation coefficients are called "saturation" or "loadings," and they tell us to what extent each test is "saturated" with  $g$ . From these coefficients, together with the original correlations between the actual tests, we derive multiple regression equations which yield the estimated  $\hat{g}$  for each person. The regression coefficients tell us how much of the variance of a person's  $g$  may be accounted for by the variance of each of the tests.

The Theory of Accidents does not enable us to go so far. It does not provide a method by which to estimate a person's individual "liability" or "prone"ness" to accidents. But it does, like factor analysis (f.-a.), work with a hypothetical variable, whose correlations with the periods over which the observations extend are estimated.

There is, of course, not complete congruence between the two methods. In f.-a. it is the relations of particular observed correlations between the tests which make us assume the presence of a common factor,  $g$ . In the Theory of Accidents, one concludes from the approximate sameness of the amount of correlation of different testing periods of the same length with  $\lambda$  the presence of a personal liability or proneness to accidents. But, as I shall show, this does not imply a difference in principle between the two methods.

For the purpose of investigating the logical and analytical relationship between f.-a. and the Theory of Accidents it is not necessary to consider the results of applying psychological tests to the persons whose accident liability is to be estimated. I have spoken above of the periods over which the observations of accidents in a certain group of persons extend as "testing periods," because each such period must logically be regarded as a sort of test or experiment on the person's liability to accidents, or as a set of such experiments. We may also, as I shall show, regard the different types of accidents that

occurred in such a period as so many tests or experiments on the person's liability. The testing periods or the types of accidents occurring in them have then precisely the same position as the actual tests, be they artificial or simply the subjects of the school curriculum, have in f.-a. The number of accidents, or of the different types of accidents, incurred by a person in the testing period thus corresponds exactly to the scores of the individuals in the different mental tests.

Such two-fold possibility of applying factor analysis to accident data corresponds precisely to the distinction made by Chambers (*loc. cit.*, 1941) between "liability to accidents" and "accident proneness." The first includes all risks inherent to an occupation, as well as any personal qualities which are involved in accident causation; the latter term is restricted to the personal elements in susceptibility to accidents.

As will be seen, the application of factor analysis to accident data enables us to deal with each of these two concepts separately (par. 1.3 and 1.4).

(2) Let us briefly examine the analytical relationship between the two methods.

One of the fundamental equations of f.-a. (more precisely of Spearman's Two-Factor Theory, whose later modifications I shall only consider where they have any bearing upon the relationship in which we are here interested), is

$$r_{ab} = r_{ag} \cdot r_{bg} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

which means that if the correlation between two tests,  $a$  and  $b$ , is due solely to parts of their respective variances being accounted for by a common factor  $g$ , then their correlation coefficient equals the product of their respective saturations (correlations) with that common factor. In other words, the correlations between the actual tests are derivable from their respective saturations with the hypothetical test by means of the above relation.

Similarly, in the theory of accidents, the correlation between two testing periods (in which the same individuals were observed with regard to accidents) is considered to be due to the factor of personal liability remaining the same for an individual in both periods, though varying from individual to individual. Miss Newbold (*loc. cit.*) has compared the correlation coefficients between different periods calculated according to the product-moment formula with their estimates under the assumption of personal liability as a common factor in any two periods and obtained a very satisfactory conformity (Table 3).

The formula which Miss Newbold derived from Tschuprow's general equations for estimating the parameters of theoretical distributions from those of the observed values, for the correlation between the  $\lambda$ 's and any other measure  $x$  estimated from the observed correlation between  $A_i$  and  $x$  is, in the special case of the accident distribution

$$r_{\lambda i} = \frac{r_{x A_i}}{\sqrt{1 - \frac{\overline{A_i^2}}{\sigma_{A_i}^2}}} \quad (\S 6 \text{ i, Appendix}) \quad . \quad . \quad . \quad . \quad (2)^*$$

For estimating the correlation between the  $A_i$ 's and the  $\lambda$ 's she obtains

$$r_{A_i A_j} = \sqrt{1 - \frac{\overline{A_i^2}}{\sigma_{A_i}^2}} \quad (\S 6 \text{ ii, Appendix}) \quad . \quad . \quad . \quad . \quad (3)$$

\* Where the  $\overline{A_i^2}$ 's denote the observations in the testing periods  $i = 1, 2, 3 \dots n$ .  $A_i$  the mean value of  $A_i$  for any given period,  $\sigma_{A_i}$  the standard deviation of the  $A_i$ 's in any given period.



Putting  $A_1$  for  $A$ , in (2) and (3) and  $A_2$  for  $x$  in (2) we have from (3)

$$r_{A_1\lambda} = \frac{r_{A_1A_2}}{r_{A_1A_2}} \text{ or } r_{A_1\lambda} = r_{A_1A_2} \cdot r_{A_2\lambda} \quad \dots \quad (4)$$

which says the same as (1), namely that the correlation between the  $A$ 's, that is between the measures of the same individuals with regard to accidents in two different testing periods, is solely due to the common factor.

In order to test this relationship between the observed correlations and the correlations with  $\lambda$  numerically, I used the data given in E. Farmer's and E. G. Chambers "Study of Accident Proneness among Motor Drivers," for a group (A) of 166 motor drivers of whom accident records were obtained for 5 years.

Table 1 shows the accident distributions of this group for each of the testing periods, i.e. for each of the 5 years.

TABLE 1

(From Chambers and Farmer, *loc. cit.*)

*Frequency Distributions of Accidents of 166 Motor Drivers for 5 Consecutive years of exposure*

No. of Accident	Frequency				
	1st year	2nd year	3rd year	4th year	5th year
0 ... ..	45	40	37	39	41
1 ... ..	36	59	52	55	56
2 ... ..	40	35	43	40	36
3 ... ..	19	13	19	20	14
4 ... ..	12	12	10	7	14
5 ... ..	8	3	2	3	3
6 ... ..	3	3	1	2	—
7 ... ..	2	1	—	—	2
8 ... ..	1	—	1	—	—
9 ... ..	—	—	1	—	—
Mean ... ..	1.8133	1.5422	1.6145	1.5060	1.5361
S.D. ... ..	1.706	1.442	1.459	1.293	1.413

Table 2 gives the correlations of each testing period with  $\lambda$  estimated according to formula (3).

TABLE 2

(From Chambers and Farmer, *loc. cit.*)

*Correlations between Observed Accidents and  $\lambda$  estimated according to Formula (3)*

Period of Exposure					Mean Accident Rate	$r_{A\lambda}$
1st year	...	...	...	...	1.8	.614
2nd "	...	...	...	...	1.5	.508
3rd "	...	...	...	...	1.6	.491
4th "	...	...	...	...	1.5	.315
5th "	...	...	...	...	1.5	.480
2 years	...	...	...	...	3.6	.693
3 "	...	...	...	...	5.0	.744
4 "	...	...	...	...	6.5	.755
5 "	...	...	...	...	8.0	.791

Table 3 (col. 2) gives the correlations between any two of these periods with regard to the number of accidents each individual incurred in these years calculated according to the product-moment formula

TABLE 3

*Product Moment Correlations between different Years of Exposure and Correlations Estimated according to formula (4)*

Pairs of Periods	Product Moment Correlation (from Ch. & F., l.c.)	Estimated Correlation	Difference	Standard Error
	(1)	(2)	(3)	(4)
1-2 ... ..	·298	·312	·014	·070
1-3 ... ..	·235	·3014	·0664	·073
1-4 ... ..	·177	·1934	·0164	·075
1-5 ... ..	·274	·2946	·0176	·071
2-3 ... ..	·328	·2494	—0786	·068
2-4 ... ..	·176	·1600	—016	·075
2-5 ... ..	·265	·244	—021	·072
3-4 ... ..	·212	·1548	—0572	·074
3-5 ... ..	·273	·2357	—0373	·071
4-5 ... ..	·224	·1512	—0728	·074

Col. 3 of the same table shows the values of the correlation coefficients between different periods of observation estimated according to formula (4).

Col. 5 gives the standard errors of the observed coefficients.\* As will be seen, they are with one single exception higher than the differences between the values calculated from the observations and the estimated values, so that the differences (col. 4) may be attributed to fluctuations of sampling.

From this we may conclude that the same analytical relation holds good between the correlation coefficients calculated from the observed values and the estimated correlation coefficients between the observed and the hypothetical variables, in both f.-a. and theory of accidents. Consequently, we are justified in either case in ascribing the correlations between the tests or testing periods to the presence of a common factor. This common factor we call  $g$  in the case of f.-a., and  $\lambda$  in the case of the Theory of Accidents.

(3) We may now proceed to establish the functional identity of what we call "saturations" in f.-a. and the quantities  $r_{\lambda\lambda}$  of the accident theory. I should like to stress the point that it is only the *functional* identity of the two quantities which I intend to establish. By this I mean that they denote the same analytical operation. Nothing whatever is stated about their qualitative identity. A common factor may appear not only as accounting for the correlation of mental tests, but as accounting for the correlation of other kinds of psychological tests (or even not psychological tests) if the quantitative relations between such correlations indicate the presence of such a factor. We may thus obtain a common factor underlying the correlations between intelligence tests or a common factor underlying the relations between accident tests (our "testing periods"). This does not in itself imply a relationship between these factors, let alone their qualitative identity.

\* Calculated according to the formula  $\frac{1-r^2}{\sqrt{n}}$ , which, applying strictly only to samples from a normal universe, can in our case only be looked upon as a substitute for the unknown standard error.

The conception of the  $r_{i\lambda}$ 's as standing for the same mathematical operation as the saturations with  $g$  implies that all the doubts as to the invariance and uniqueness of  $g$ , which the post-Spearman development of the theory of f.-a. has brought to light, apply as well to  $\lambda$ . But it seemed best to leave these complications out of this account, which does not claim to be more than a first picture of the relationship between f.-a. and the theory of accidents.

In f.-a. we use the correlation coefficients calculated from the observed values in the form of the "correlation matrix" in order to derive the "saturations," that is, the correlation of each test with the fictitious test  $g$ . Should these correlations obtained according to Spearman's method prove to be approximately the same as the  $r_{A\lambda}$ 's obtained by Miss Newbold's formula, then the conclusions as to their operational identity would seem justified.

I admit that caution is necessary in using the coefficients obtained by the product moment formula from J-shaped distributions, because of the high error necessarily attached to such correlation coefficients. But that they are by no means devoid of meaning has been shown by Tschuprow (*Korrelationstheorie*, chap. 7). I shall return to this question in detail in par. 7.

Furthermore, it may be questionable whether the differences of the  $r_{A\lambda}$  (Table 2) are significant. The approximate "sameness" of their values is often adduced as indication of the presence of  $\lambda$ . As we shall see, such "sameness" in value is by no means necessary for assuming a constant liability. In fact, they are not the same, as a difference between .614 and .315 may well be considered to be significant. Such a view would have the advantage of being more in harmony with the actual conditions. Even if we could assume that the outer conditions in each year (testing period) were exactly the same—and it is only under this assumption that we are entitled to expect that the correlation coefficients of each period with  $\lambda$  should remain the same—we cannot *a priori* exclude any influence experience might have upon the number of accidents.

I shall, therefore, use the observed correlations between the different one-year periods as elements of the "correlation matrix," calculate the saturations of each testing period with  $\lambda$  and compare the saturations thus derived with the quantities  $r_{i\lambda}$  of Table 2 (col. 4, first 5 values).

The calculation is shown in Table 4.

The saturations of each period with  $\lambda$  are in the chronological order of the testing periods:

.49            .54            .53            .39            .52

as compared with the quantities  $r_{A\lambda}$ , Table 2:

.61            .51            .49            .32            .48

If we consider the conformity of the two series as satisfactory, then the operational or functional identity of the two quantities, saturations and  $r_{i\lambda}$ 's may be considered to have been established.

The advantage of supplementing the theory of accidents by the methods of f.-a. is this. From the values of the first series we infer (considering their differences to be significant) how great is the saturation of each period with  $\lambda$ . This means that we now have an indication which of these periods we could best use for a rough estimate of a person's liability to accidents. The greater the saturation, the truer the picture which we get from the number of a person's actual accidents in a period. Thus the numbers of accidents of a person in the second year may be used as a much better estimate for the person's  $\lambda$  than those

TABLE 4

*Calculation of the Period's Saturation with  $\lambda$  according to Spearman's method*

Matrix of Correlations taking the Periods in their Chronological Order

	1	2	3	4	5
1	—	.298	.235	.177	.274
2	.298	—	.328	.176	.265
3	.235	.328	—	.212	.273
4	.177	.176	.212	—	.224
5	.274	.265	.273	.224	—

The same Matrix rearranged in the Order of the columnal Totals.

	2	3	5	1	4
2	—	.328	.265	.298	.176
3	.328	—	.273	.235	.212
5	.265	.273	—	.274	.224
1	.298	.235	.274	—	.177
4	.176	.212	.224	.177	—

Period	$A^*$	$A^2$	$A' \mid$	$A^2 - A'$	$2.1$	$T - 2.1$	$\frac{A^2 - A'}{T - 2A}$	Saturations with $\lambda$
2	1.067	1.128	.297	.831	2.134	2.820	.2947	.54
3	1.048	1.098	.282	.816	2.096	2.858	.2855	.53
5	1.036	1.064	.270	.794	2.072	2.882	.2755	.52
1	.984	.968	.250	.718	1.968	2.986	.2404	.49
4	.819	.671	.157	.514	1.638	3.316	.1550	.39
	$T =$ 4.954							

\*  $A$  = sums of rows of Matrix.†  $A'$  = sums of rows of squared coefficients.

in the fourth year. We should, however, never judge a person's  $\lambda$  from his accidents in a single period. F-a. enables us to use all the periods combined for estimating a person's  $\lambda$ ).

This result appears to express in terms of factor analysis the conclusion reached by Mr. Chambers (*loc. cit.*, 1941) of a  $\lambda$  changing with time.\*

What made Mr. Chambers arrive at that conclusion was that the invariance of certain quantities with regard to time demanded by what Mr. Yule has called the assumptions of the "Simple Case," was found not to apply to these quantities if calculated from the observations of accident data.

Thus it was specially Charlier's Coefficient of Disturbance, an invariant with regard to time if the conditions of the "Simple Case" are given, which was found to decrease with time. This was taken as an indication that  $\lambda$  plays a

\* There is, however, this point of difference: whereas Mr. Chambers compares periods of exposure of different lengths, I could only use equal successive periods for estimating the influence of "experience" in a given occupation on the frequency of accidents.

diminishing part as the period of experience increases. We may express this by saying that  $\lambda$  changes with time.

Now, the interpretation of "saturation" in f.-a., makes us arrive at the same view as to the functioning of  $\lambda$ . If we find, as in our experiment, that the fourth period has the lowest and the second the highest saturation with  $\lambda$ , this means that a person's  $\lambda$  would not be called upon in the fourth period to such an extent as it was in the second. Although according to the conceptual structure of f.-a. we would have to regard a person's  $\lambda$  as remaining the same for all the testing periods, yet its coming into play differs from period to period according to the saturation. Even though the downward trend of our saturations is far from perfect, we may, at least, find an indication of a general downward trend which, in Mr. Chambers's words, means that  $\lambda$  "plays a diminishing part as the period of experience increases." That "part" is, according to factor analysis, indicated by the magnitude of the saturations for the different testing periods.

If the available experimental material were not too slender a basis for drawing far-reaching conclusions, we might infer from this that the treatment of accident data by the methods of f.-a. is capable of providing the analytical expression for the assumption that, as Prof. Greenwood puts it, "the diathesis or predisposition could not be modified, but its practical consequences could." For, as already pointed out, although the  $g$  of a person is in Spearman's Theory assumed to be invariant with regard to the different tests, it is not called upon in all the tests to the same extent. For the case of Liability to Accidents this would mean that we are able to express quantitatively to what extent a  $\lambda$  which is assumed to remain the same for a given person was being called into play as the period of experience was extended.

(4) Instead of periods of observation we may use different types of accidents incurred by individual persons during the period of observation as "tests" in the sense that the term is used in f.-a. In doing so it will become evident that the approximate equality of values of  $r_{i\lambda}$  in different equal testing periods is only a very special case of the fundamental quantitative relation between the correlation coefficients which makes us assume the working of a common factor.

In the study by Farmer and Chambers the accidents are classified into five categories: Errors of judgment, Over-runs, Skids, Blameless and Miscellaneous, the definition of which is given on pp. 15-16 (*loc. cit.*). The intercorrelations between these types of accident with regard to the persons incurring them were calculated by Farmer and Chambers by means of the product-moment formula and are given in Table 5.

Farmer and Chambers then proceed to tabulate (Table IX) the mean number of different types of accidents for drivers having different numbers of each type of accident. Thus, for instance, the 166 drivers are grouped according to the frequency of occurrence of "errors of judgment" accidents among them and for each frequency class, *i.e.* for each value of the variable, the mean number of accidents of the four other types is calculated. The authors reach the conclusion that drivers with a high number of accidents in one type will also have a high mean number of accidents of other types. This may be taken to show that there is common liability to accidents underlying all different types of accident occurrence.

But that is all that can be inferred from the data without employing the more

TABLE 5

*Product Moment Correlations between Different Types of Accident*

							(Correlation Coefficient, $r_{BIB}$ (from Ch. & F, l.c.)
(1) Errors of Judgment—Over-runs	...	...	...	...	...	...	.367
" " —Skids	...	...	...	...	...	...	.148
" " —Miscellaneous	...	...	...	...	...	...	.234
" " —Blameless	...	...	...	...	...	...	.161
(2) Over-runs —Skids	...	...	...	...	...	...	.077
" —Miscellaneous	...	...	...	...	...	...	.233
" —Blameless	...	...	...	...	...	...	.149
(3) Skids —Miscellaneous	...	...	...	...	...	...	.161
" —Blameless	...	...	...	...	...	...	.214
(4) Miscellaneous —Blameless	...	...	...	...	...	...	.390
(5) Blameless	...	...	...	...	...	...	—

powerful method of f.-a. The theory of accidents does not draw any conclusions from the inequality of correlations between the different types as to which types of accidents are likely to show better than others the degree of personal proneness to accidents. This may be ascertained by calculating

TABLE 6

*Calculation of Saturations with the different Types of Accident**Correlation Matrix (rearranged according to magnitude of Totals)*

	4	5	1	2	3
4	—	.390	.234	.233	.161
5	.390	—	.161	.149	.214
1	.234	.161	1	.367	.148
2	.233	.149	.367	—	.077
3	.161	.214	.148	.077	—

*Computation of Saturations by Spearman's Method*

Types of Accident	.i	.i <sup>2</sup>	.i <sup>3</sup>	.i <sup>2</sup> - .i <sup>1</sup>	.2i	T - 2i	$\frac{i^2 - i^1}{1 - 2i}$	Saturations with $\lambda_p$
Miscellaneous ...	1.018	1.0369	.2871	.749	2.04	2.232	.3360	.580
Blameless ...	.914	.835	.246	.589	1.83	2.44	.2416	.491
Error of Judgment ...	.910	.828	.238	.591	1.82	2.45	.2412	.491
Over-runs ...	.826	.682	.217	.465	1.65	2.62	.1777	.422
Skids ...	.600	.360	.099	.261	1.20	3.07	.0849	.291
	T =							
	4.268							

according to the methods of f.-a. the saturations of each type of accident with the common factor,  $\lambda_p$ . A high saturation will indicate that the number of accidents of this type in a person will be a safer index of that person's proneness to accidents in general than would his number of accidents of another type if that type's saturation was small.

In order, therefore, to ascertain the saturations with  $\lambda_p$  in the different types of accidents, I have (Table 6) calculated these coefficients and obtained the following order of types according to the magnitude of their saturations with  $\lambda_p$ :

Miscellaneous	Blameless	Errors of Judgment	Over-runs	Skids
.580	.491	.491	.422	.291

As might have been expected, the category "miscellaneous" having most in common with all the other types, has the highest saturation. As this is not a positive definition of one type but rather a negative one indicating that the accident did not belong to any of the other four types, we cannot derive much information from that saturation.

The second highest saturation, "blameless," and the third, "errors of judgment," are much more informative. As they are both equal, we conclude that the number of accidents to a person in either of these categories will serve equally as an index to his accident-proneness. This is at first surprising considering that in the case of "blameless" that person was the "victim," whereas in that of "errors of judgment" he was the "cause" of the accident. But if we realize what is meant by " $\lambda_p$ ," it not only ceases to be surprising but appears to confirm the "proneness"-theory in a rather interesting way.

If  $\lambda_p$  is the personal element entering into the occurrence of accidents, it must not be considered to mean only a proneness to intellectual mistakes causing the accidents. It also symbolizes the emotional and kinetic make-up of a person which makes that person liable to suffer accidents on the least provocation. In the case of driving accidents, assuming the evidence for "blameless" to be reliable, it often happens that some twist of behaviour on the part of the driver which is not covered by the regulations and sanctions of the law is wholly or partly responsible for the accident. According to the law the driver is not to blame, but in spite of that it may have been his æsthetic-kinetic make-up which was responsible for the accident. The personal factor in accidents may therefore appear either as "errors in judgment" or as "blameless," and the equality of the saturations of both with  $\lambda_p$  is in good harmony with the conception of  $\lambda_p$  as a constant personal proneness to accidents. This would afford an explanation why the same type of distribution (compound Poisson) applies to both the cause and the victim of accidents.

Looking at the two remaining types of accidents, we find that "over-runs" have a greater saturation than "skids." This too is in perfect harmony with the theory of  $\lambda_p$  as the personal factor, as "skids" are mainly machine accidents and have very little to do with such a personal factor, whereas "over-runs," though less dependent on the personal factor than "errors of judgment" or "errors of behaviour," are still more "personal" than "skids."

Table IX of the Farmer and Chambers' study mentioned above fully bears out the order of the types of accidents according to the magnitude of their saturations with  $\lambda$ .

For instance:

(1)	(2)	(3)	(4)	(5)	(6)
No of "Errors"	No of Drivers	Mean no of			
		Over-runs	Skids	Miscellaneous	Blankness
0	66	.6061	.3182	1.8788	3.7212
1	55	.8000	.5636	1.9818	3.5273
2	26	.8846	.5000	2.2308	3.2308
3-5	19	2.1579	.6842	3.4211	4.8947

Comparing each column with col. 1, we find that the values of col. 5 (Miscellaneous) correspond best with those of col. 1, next with those of col. 6 then with those of col. 3, and, lastly, with those of col. 4 (Skids). But the method of f.-a. provides an exact and compact description of the results given in these tables.

In order to write down the specification equations for each type of accident, showing how its variance is made up by the general factor common to all the tests and a specific factor peculiar to each type, we need only compute what in the general theory of correlation is called the "coefficient of alienation" and in f.-a. the "saturation with the specific." This coefficient is determined as the square root of the difference between unity and the square of the saturation with  $g$  for the test in question.

The specification equations for our example are given below (the types of Accident denoted by  $B_i$ ):

$$B_4 = .580\lambda_p + .815s_4$$

$$B_5 = .491\lambda_p + .871s_5$$

$$B_1 = .491\lambda_p + .871s_1$$

$$B_2 = .422\lambda_p + .907s_2$$

$$B_3 = .291\lambda_p + .957s_3.$$

(5) A consequence of great practical importance of supplementing the Theory of Accidents by the methods of f.-a. is that it would enable us to estimate the individual  $\lambda_p$ 's.

The Theory of Accidents cannot achieve this. All it can do is to conclude that the persons differ in their liabilities to accident, but it does not tell us by how much they differ. Factor analysis, on the other hand, is able to estimate the individual amounts of  $g$ . Treating  $\lambda_p$  as a common factor in the sense in which the term is used in f.-a., puts us in a position to estimate the individual amounts of  $\lambda_i$  and, thus, to state by how much the individual persons differ from one another with regard to accident proneness.

In order to show in a numerical example how this could be achieved, I have exhibited in Table 7 the calculation of the regression coefficients for the estimation of the individual  $\lambda_p$ , possessed by the persons of our experiment according to Spearman's method.

As the basis for the computation the saturations of Table 6 were used, that is, the saturations of the different types of accidents because their differences seemed more significant than those of the saturations of the testing periods, Table 4.



The regression equation at which we thus arrive: Estimated  $\lambda_p = .36B_1 + .26B_5 + .26B_1 + .21B_2 + .13B_3$  tells us how the variance of  $\lambda_p$  is made up by the contributions from each of the types of accident.

TABLE 7  
*Estimating  $\lambda_p$  by means of Regression (Spearman's Method)*

Types of Accident.	$r_{19}$	$r_{19''}$	$1 - r_{19}^2$	$\frac{r_{19}^2}{1 - r_{19}^2}$	$\frac{r_{19}}{1 - r_{19}^2}$	Regression-Coefficient $\frac{1}{1 + \sum \frac{r_{19}^2}{r_{11}^2}}$
Miscellaneous ...	.580	.336	.6640	.506	.8735	.3563
Blameless ...	.491	.2416	.7584	.3185	.6474	.2640
Error of Judgment ..	.491	.2412	.7588	.3179	.6471	.2640
Over-runs ...	.422	.1777	.8223	.2161	.5132	.2093
Skids ...	.291	.0849	.9151	.0928	.3180	.1297
				S - 1.4513		

$$\text{Estimated } \lambda_p = .36 B_1 + .26 B_5 + .26 B_1 + .21 B_2 + .13 B_3.$$

The values for  $B_1, B_2, \dots, B_5$  in the regression equation are to be inserted in standardized form, *i.e.* as deviations from their respective means and divided by their respective standard deviations.

If we want to know a particular person's amount of accident proneness, all we have to do is to express in standardized form the number of accidents he has had of each type and to insert the quantities so obtained into the regression equation. Even should there be a large error attached to the estimates, taken as absolute values, they would provide a fairly accurate picture of the relative values of  $\lambda_p$ , that is, of the differences between the individuals with regard to accident proneness.

At this point I should like to state explicitly that I am not concerned with establishing the "existence" of Factors or of a General Factor in accident causation, nor with discussing the intrinsic meaning of such a Factor, but that I am approaching the matter from the standpoint of using factors as a sort of co-ordinates to which a complex of data may be referred, in order to bring to a point the quantitative inferences to be drawn from them.

(6.1) Hitherto our analysis has been mainly concerned with the general factor that could be extracted from accident correlations.

If we wanted to obtain some information about the nature of the specifics in such cases, we may do so by choosing another way of approach, *viz.*, by treating

TABLE 8  
*General form of the Association Table*

	$O_y$	$I_y$	Total
$O_x \dots$	$p_{I}$	$p_{II}$	$p_I + p_{II}$
$I_x \dots$	$p_{III}$	$p_{IV}$	$p_{III} + p_{IV} = p_{I'}$
Total	$p_I + p_{III} = p_{0y}$	$p_{II} + p_{IV} = p_{1y}$	$p_I + p_{II} + p_{III} + p_{IV}$

1st Year	2nd Year			Correlation-Coefficient	Correlation of Table 3
	16 24	29 97	45 121	$r = .1634$ $s.e. = .0757$	
	40	126	166		
1st Year	3rd Year			$r = .064$ $s.e. = .0775$	(.235)
	12 25	33 96	45 121		
	37	129	166		
1st Year	4th Year			$r = .014$ $s.e. = .078$	(.177)
	11 28	34 93	45 121		
	39	127	166		
1st Year	5th Year			$r = .153$ $s.e. = .0757$	(.274)
	16 25	29 96	45 121		
	41	125	166		
2nd Year	3rd Year			$r = .204$ $s.e. = .0745$	(.328)
	15 22	25 104	40 126		
	37	129	166		
2nd Year	4th Year			$r = -.079$ $s.e. = .0773$	(.176)
	7 32	33 94	40 126		
	39	127	166		
2nd Year	5th Year			$r = .004$ $s.e. = .078$	(.265)
	10 31	30 95	40 126		
	41	125	166		
3rd Year	4th Year			$r = .079$ $s.e. = .0773$	(.212)
	11 28	26 101	37 129		
	39	127	166		
3rd Year	5th Year			$r = -.038$ $s.e. = .078$	(.273)
	8 33	29 96	37 129		
	41	125	166		
4th Year	5th Year			$r = .045$ $s.e. = .0775$	(.224)
	11 30	28 97	39 129		
	41	125	166		

the "tests"—be it the periods of observation or the types of accident—as Attributes. Each of the "tests" has then only two states: presence or absence. The different shades of intensity of presence are left out of account. In our case this is achieved by leaving out of account the differences in the numbers of accidents and classifying the persons only according to whether they had an accident or not, be it in a given period or of a certain type.

The data given in Appendix D of the paper by Farmer and Chambers enable us to deal with the periods of observation in this way; as to the second case, where we used the types of accidents as "tests," the Report does not give the detailed information necessary for such analysis.

The characteristics of the persons which we shall use are: "Accident in the first year," "Accident in the second year," and so forth for each of the five periods of observation, each characteristic having the two states of presence and absence. For any two of the periods, the persons may then be classified according to whether they had accident in both the periods, in one only, in the other only, or in neither. (Table 8 gives the Association Tables set up in this way for the ten possible pairs of characteristics.)

For determining the degree of stochastic connection between the attributes, I calculated (following the practice advocated by W. Johannsen, *Elemente der Exakten Erblichkeitslehre*, 2nd ed. pp. 343–350, for reasons which will become apparent as we proceed), not the coefficient of association, but that of correlation

$$r = \frac{\sum p_{xy}a_y - nb_xb_y}{n\sigma_x\sigma_y},$$

which formula reduces in the case of Alternative Variation where the "presence" of the attribute is taken to represent the value 1 of the "variable" and the "absence" the value 0, to

$$r = \frac{p_{11}p_{00} - p_{10}p_{01}}{\sqrt{p_{00} \cdot p_{10} \cdot p_{01} \cdot p_{11}}} *$$

The result is very remarkable. The correlations between the periods of Table 3, which I have added in brackets after each of the new correlations, are now so reduced that they can hardly be considered to differ significantly from zero. In no case does the correlation exceed three times the standard error calculated according to the formula:

$$\sqrt{n-1},$$

this formula is not strictly applicable here because the universe of our observations is not normal, not even symmetrical; but it is better than nothing if we want to judge the reliability of our coefficients, and only in three cases does it exceed twice the standard error.

We may, therefore, say with some confidence that the characters in question are uncorrelated. This would imply that these psychological characters are behaving according to a law which, as is well known, is generally obeyed by biological characters: they combine freely, each character's action being undisturbed by that of the others.

\* (See Table 8 for the meaning of the letters.) This coefficient, also known as Mean Square Contingency, can be derived in different ways.

(6.2) It is such absence of correlation between the heritable unit characters of plants and animals which forms the statistical content of Mendel's laws of segregation and recombination.

The resemblance between the association tables of Table 8 and those we meet with in Mendelian investigations is so striking that one is tempted to press the analogy a little further.

When we are dealing in biological research with two characters—comparable to any two "tests" in our case—say  $A, a$  and  $B, b$ , the capital letters denoting presence, the small letters absence, in each of which presence dominates over absence, then the four different classes of individuals in the  $F_2$ -generation, viz. those with both characteristics in the "presence" state, with only one in the presence state, with only the other in the presence state, and with both in the absence form, stand in the ratio 9 : 3 : 3 : 1.

This ratio satisfies the conditions that the number of individuals having  $A$  in their genetic make-up should be to that of individuals without  $A$  as 3 : 1, and, at the same time, the number of individuals with  $B$  in their genetic make-up should be to the number of individuals without  $B$  as 3 : 1.

For any given number of observations we may calculate the expected number of individuals in each of these four classes together with the standard error attached to each of the frequencies, according to the method given by W. Johannsen, *loc. cit.*, 508–515. It is this biological aspect of our analysis that made me wish to conform with the biologist's practice in determining the degree of stochastic connection, Table 8.

For our 166 observations we have the following expectation of frequencies in the four classes containing individuals with accidents in two specified periods, with accidents in one only, with accidents in the other only, and with accidents in neither, together with the standard error of each expectation (calculation shown in Table 9):

$$93.24 \pm 6.4 : 31.14 \pm 5.03 : 31.14 \pm 5.03 : 10.38 \pm 3.12$$

TABLE 9

*Calculations of Expectations according to Mendelian Theory, together with the Standard Errors of such Expectations*

(After W. Johannsen, *loc. cit.*, pp. 508–515)

Ideal Numbers (Ratios)      ...      ...      ...      9 : 3 : 3 : 1      Total ( $k$ ) = 16  
Expectation ( $q$ ) for  $n = 166$ :

Ideal Numbers  $\cdot \frac{n}{K}$       ...      ...      ...      ...      93.42 : 31.14 : 31.14 : 10.38

*Formula for Standard Errors of Expectations*

$$\text{st.e.} = \sqrt{\frac{q(n-q)}{n}}.$$

For  $q = 93.42$ ,  $n - q = 72.58$ ; st.e. = 6.391;

„  $q = 31.14$ ,  $n - q = 134.86$ ; st.e. = 5.03;

„  $q = 10.38$ ,  $n - q = 155.62$ ; st.e. = 3.12.

The expected proportions together with their st.e. are, therefore:

$$93.42 \pm 6.4 : 31.14 \pm 5.03 : 31.14 \pm 5.03 : 10.38 \pm 3.12.$$

Comparing the observed frequencies (from Table 8):

97 : 29 : 24 : 16
96 : 33 : 25 : 12
93 : 34 : 28 : 11
96 : 29 : 25 : 16
104 : 25 : 22 : 15
94 : 33 : 32 : 7
95 : 30 : 31 : 10
101 : 26 : 28 : 11
96 : 29 : 33 : 8
97 : 28 : 30 : 11

with the expectations we find that the limit of *once* the standard error is exceeded

- 2 times out of ten in the 1st class;
- 5 times out of twenty in the 2nd and 3rd classes;
- 2 times out of ten in the 4th class.

which shows a reasonably good conformity between expectation and observation.

For the proportion between the number of individuals with and without accident in each period we have from Table 1

1st year : 121 : 45
2nd „ : 126 : 40
3rd „ : 129 : 37
4th „ : 127 : 39
5th „ : 125 : 41.

The expected ratio together with the standard error is

$$124.5 \pm 5.6 : 41.5 \pm 5.6,$$

which shows good conformity between observations and expectation.

For the case under consideration we may thus conclude that not only are the characters uncorrelated, but that the numerical proportions of the individuals with regard to the presence and absence of these characters are those demanded by Mendelian Theory.

(6.3) It now becomes evident what produces the correlations of Table 3 between the periods, and, consequently, necessitates the assumption of a general factor. As long as we are dealing with the characteristics (the “periods,” in our case), we find no significant correlation. It is by taking into account the *individual differences* between persons with regard to the number of accidents that correlations obtain and together with them emerges a general factor. This is in good harmony with the assumption of individual differences in accident proneness.

In other words: it is pure chance whether a person who had an accident in one period has also one in any other specified period; but the association of the *frequencies* of accidents suffered (or caused) by a person in two specified periods is not more entirely a matter of chance: as far as the correlation between two such periods goes, there exists a causal connection between the two frequencies which enable us to predict to a certain extent a person's number of accidents in one period from the number of accidents he had in another.

The periods of observation which in our case have the rôle of the "tests" in factor-analysis are thus analyzed into two parts: a qualitative and a quantitative one. The latter—derived from the individual differences—represents the general factor; the former cannot have any other meaning but that of the Specifics. This not only because they are like the Specifics orthogonal to one another (and to the general factor), but also for logical reasons. They represent that which remains after that part of the variance of each "test" which accounts for the interrelatedness of the "tests" has been subtracted. They are that which makes the "test" what it is and, therefore, differentiate it from any other "test." And this property—which sometimes is used for defining quality—is meant by the term Specific.

Mendelian analysis as applied here thus enables us to connect more concrete ideas with the concept of Specifics, and, hereby, also to get a clearer idea of the statistical meaning of the general factor.

Apart from that advantage for the understanding of factor analysis, the fundamental unity—in spite of very important differences—is brought out between the laws governing the distribution of qualities in biological and certain psychological populations. But it would not be admissible to generalize this conclusion on the slender basis of one experiment.

(7) The application of the methods of factor-analysis to accident data will probably meet with the objection on the part of psychologists that factor analysis should be applied only if the distributions of scores were more or less symmetrical; sometimes even "normality" is demanded. Otherwise, it is argued, the errors are too high to let the correlation coefficients appear suitable for serving as a foundation upon which to build up the system of parameters peculiar to factor analysis.

The application of f.-a. to accident data as advocated in this paper would, therefore, seem to raise the question of the significance of correlation coefficients obtained from J-shaped distributions.

A fully satisfactory answer could only be given on the basis of a knowledge of the sampling distribution of such coefficients. At present we know little about the sampling distribution of correlation coefficients (and, *a fortiori*, of saturations and tetrad differences) in non-normal populations. But some light may be shed upon the problem by considering the stochastic nature, or the meaning, of such correlations.

This problem was treated in a purely academic way and without regard to any special statistical theory like that of accidents or that of factor analysis, by Tschuprow in chapter 7 of his *Grundbegriffe und Grundprobleme der Korrelationstheorie*, translated into English by Kantorowicz as *Mathematical Principles of Correlation*. If the distribution of the single variables is not what he with Lexis calls "normal stabil," then the correlation between such variables can also not be "normal stabil." It is not that the correlation coefficients calculated from the observations lose their significance in such correlations, but that they must be interpreted as referring to "not normally stable" distributions.

"If . . . the stability is abnormal because the joint frequency distribution changes, then the calculated presumptive values have no longer the same meaning because the coefficients ascertained by them do not characterize any definite joint frequency distribution but, on the contrary, refer to the totality of changeable joint frequency distributions, and must be under-

stood as a mean value of *a priori* coefficients which characterize individual joint frequency distributions. The computation remains the same in all cases: the empirical correlation coefficients, for instance, is always calculated by the same formula. But what is found by its calculation varies in meaning: at times the meaning of the number calculated can be precisely seized, at other times its subject is more or less vague."

(Tschuprow, *Theory of Correlation*, chp. 7, § 4.)

### Conclusions

The conclusions reached in this paper may be summarized as follows:

- (1) The statistical Theory of Accidents and that of Factor Analysis show a close logical and analytical relationship.
- (2) This relationship makes it appear admissible to supplement the methods of the Theory of Accidents by that of Factor Analysis, and vice versa.
- (3) The advantages derived by doing so are these:
  - (i) It enables us to distinguish between different periods of observation with regard to their saturation with  $\lambda$  ("Liability to Accidents");
  - (ii) it enables us to differentiate between the different types of accident with regard to their saturation with  $\lambda_p$  and, thus to decide which type of accident may be looked upon as being the most "typical" and, therefore, the most useful one for judging a person's "proneness to Accidents";
  - (iii) it enables us to determine numerically the amount of  $\lambda_p$  for each person individually.
- (4) If "Accident Incidence" in the five periods of observation of our experiment is considered to represent six attributes of the individuals, then these attributes or characters appear to be uncorrelated among themselves and behave like biological unit characters.
  - These characters satisfy the conditions for the Specifics of Factor Analysis.

A TABLE OF THE VARIANCE OF  $\sqrt{x}$  WHEN  $x$  HAS A POISSON DISTRIBUTION

By J. O. IRWIN

IN applying analysis of variance to data of Poisson type, it is advantageous to use the square root of the variate as a transformed variate, for the latter has a variance which is almost independent of the mean  $\mu$ . Large sample theory gives  $V(\sqrt{x}) = \frac{1}{4}$  independently of  $\mu$ , for if

$$\begin{aligned} u &= \sqrt{\frac{v}{\delta x}} \\ \delta_u &= \frac{2\sqrt{(\mu)}}{V(x)} \\ V(u) &= \frac{V(x)}{4\mu} = \frac{1}{4} \end{aligned}$$

The variance is surprisingly near  $\frac{1}{4}$  even for quite small values of  $\mu$ . M. S. Bartlett,<sup>1</sup> who made a careful examination of the square-root transformation, tabulated  $V(\sqrt{x})$  for  $\mu = 0.0$  (0.5) 15.0. The present table gives the values for  $\mu = 0.0$  (0.1) 15.0, 20.0, 50.0, 100.0 and  $\infty$ ; it seems worth while, therefore, to put it on record.

Up to  $\mu = 15.0$  the values were calculated from Table LI of *Tables for Statisticians*, Vol. I. The relative theoretical frequencies ( $f$ ) are there given to six decimals only, seven decimals were used in the square roots. Under these conditions the variance of  $\{\Sigma f\sqrt{x}\}^2$  due to the omitted decimals is  $4\{\Sigma f\sqrt{x}\}^2 V\{\Sigma f\sqrt{x}\}$  or  $4\{\Sigma f\sqrt{x}\}^2 \times \frac{\Sigma x}{12}$  (in units of the 6th decimal). Up to  $\mu = 15$ ,  $\{\Sigma f\sqrt{x}\}$  never exceeds 4, and more than 40 frequencies are never required; the variance of  $\{\Sigma f\sqrt{x}\}^2$  is therefore less than  $(32 \times 40 \times 39)/12 = 4160$ . The standard error of the result due to omitted decimals is therefore less than 65 units in the sixth decimal and about 60 at  $\mu = 15$ . An error of two units in the fourth decimal is therefore not impossible at the upper end of the table. In fact the table was differenced and the values marked with an asterisk altered by 1 unit in the fourth decimal from those originally calculated. This makes the differences run slightly more smoothly.

For 20, 50 and 100 the Poisson frequencies were specially calculated, and an ample number of decimals was retained to ensure four-figure accuracy in the final result.

Between 15 and  $\infty$  a linear interpolation in  $1/\mu$  or, for convenience,  $300/\mu$ , using the five values given, is sufficiently accurate. This has been found to agree within one unit in the fourth decimal with the result of a five-point Lagrange formula in  $300/\mu$ .

For example take  $\mu = 75$ . For  $\mu = 50, 75, 100$   $x = 300/\mu = 6, 4, 3$ . Accordingly  $V(\sqrt{x})$  for  $\mu = 75 = 0.2519 - \frac{2}{3}$  (0.0009) = 0.2513. The five point Lagrange formula gives the same result.

<sup>1</sup> Bartlett, M. S., *J. Roy. Statist. Soc. Suppl.*, 1936, 3, 68-78.



TABLE OF  $V\{\sqrt{\lambda}\}$   
 When  $x$  has a Poisson Distribution with Mean  $\mu$

$\mu$	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0
0.0	.0000	.4022	.3900	.3400	.3056	.2861	.2754	.2692	.2654	.2630	.2613	.2600	.2590	.2582	.2575
0.1	.0906	.4080	.3849	.3357	.3031	.2848	.2746	.2687	.2652	.2628	.2612	.2599	.2590	.2581	.2575
0.2	.1643	.4113	.3796	.3317	.3008	.2834	.2738	.2683	.2649	.2626	.2611	.2598	.2589	.2581	.2574
0.3	.2240	.4125	.3743	.3278	.2985	.2822	.2732	.2678	.2646	.2624	.2609	.2597	.2588	.2580	.2574
0.4	.2719	.4120	.3691	.3241	.2964	.2810	.2725	.2675	.2643	.2623	.2607	.2596	.2586	.2580	.2573
0.5	.3100	.4102	.3639	.3206	.2944	.2799	.2719	.2671	.2641	.2621	.2606	.2595	.2585	.2578	.2572
0.6	.3399	.4074	.3588	.3173	.2926	.2789	.2713	.2668	.2639	.2620	.2605	.2594	.2585	.2577	.2571
0.7	.3630	.4038	.3539	.3141	.2908	.2779	.2707	.2665	.2637	.2618	.2604	.2593	.2585	.2577	.2571
0.8	.3804	.3996	.3491	.3111	.2891	.2770	.2702	.2661	.2635	.2616	.2603	.2592	.2584	.2577	.2571
0.9	.3932	.3950	.3444	.3083	.2876	.2761	.2696	.2656	.2632	.2614	.2602	.2591	.2583	.2576	.2570
1.0	.4022	.3900	.3400	.3056	.2861	.2754	.2692	.2654	.2630	.2613	.2600	.2590	.2582	.2575	.2570

The values for 20.0, 50.0, 100.0,  $\infty$ , are .2551, .2519 and .2510, .2500. The values marked with an asterisk have been altered by one unit in the last decimal from those originally calculated.

## MEMORANDUM ON OFFICIAL STATISTICS

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## PART 1. INTRODUCTION

*Preliminary Observations*

1. We, the Council of the Royal Statistical Society, have considered the organisation of statistics in Government Departments and wish to submit recommendations regarding post-war requirements.

On October 13th, 1942, we appointed a Committee with the following terms of reference:

"To consider and report upon the organization of statistics in Government Departments before, during and after the war, with special reference to—

- (a) the staffing of Departments;
- (b) the relations between Departments;
- (c) the advantages and disadvantages of alternative schemes of post-war organization."

2. The Committee consisted of Professor Major Greenwood (Chairman), Mr. R. F. George, Mr. M. G. Kendall, Mr. H. Leak, Professor E. S. Pearson and Dr. E. C. Snow. Sir George Epps attended the meetings by invitation, so that as a Member of the Treasury Committee considering the post-war position he could keep in touch with our Committee. We desire to express our great

indebtedness to this Committee, whose report, with certain amendments and additions, was unanimously accepted by us.

3. It was found necessary to consider rather closely the interpretation of the expressions "Government Department" and "statistician." A clear understanding of the different possible senses in which these terms can be used is fundamental to the purposes of the enquiry and materially affects the scope and nature of our recommendations. The constructions we have put on these two terms are briefly set out as a preliminary.

#### *Classification of Government Departments*

4. The list of Government Departments in the Imperial Calendar includes a number of specialized bodies such as the British Museum, the Medical Research Council and the National Physical Laboratory, and a number of small administrative units such as the National Debt Office, the Office of the Duchy of Lancaster and the Tithe Redemption Commission. It is evident that such organizations may present special problems and provide exceptions to any general rules which are framed to cover the position of the major Departments. We have not attempted to deal with such individual cases, but have classified the totality of Departments under three heads:

(a) The major Departments, directly responsible to a Minister of the Crown, with substantial administrative functions. This class includes, among others, the Service Departments, the Treasury, the Boards of Education, Inland Revenue and Trade, the Home Office and the Ministries of Agriculture, Health and Labour (together with, in war-time, the Ministries of Supply, Food, Aircraft Production, Economic Warfare, War Transport and so forth).

(b) The minor Departments whose functions are mainly administrative or executive and which are usually affiliated to a major Department. This class, for example, includes the Office of Crown Lands, the Forestry Commission, the Mint, and the Public Records Office. We would also put in this category the Stationery Office and what used to be called the Office of Works, though in the latter case the war-time counterpart, the Ministries of Works and of Town and Country Planning, may have reconstructional functions which would put them in class (a).

(c) The Departments which are wholly or mainly scientific or technological, such as the Department of Scientific and Industrial Research, the Agricultural and the Medical Research Councils, Research Stations and the Museums and Institutes so far as they engage in scientific research.

The General Register Offices, the Government Actuary's Department and the war-time Central Statistical Office are sufficiently individual to be outside these three groups and statistically we regard the Foreign Office, Dominions Office, India Office and Colonial Office as also occupying a special position. The classification does not pretend to be perfect.

#### *The definition of "statistician" and "statistics"*

5. The science and methods of "statistics" in the modern sense range from the mere recording and tabulation of numerical data to subtle processes of inductive reasoning based on the mathematical theory of probability. The word "statistician" may be used at the present time to indicate either a recording

clerk with no special accomplishments other than an ability to see that returns are compiled as required or, at the other end of the scale, an expert engaged in applying to numerical material a complicated theoretical technique. There is no accepted definition of a statistician and there are no professional qualifications, such as exist for lawyers, medical men, actuaries and accountants, which provide any sort of criterion for deciding whether a given person has any right to claim the title. This is a state of affairs which has already been brought to the notice of the Society, and some attention will be given to it in the near future. In the meantime it is necessary to consider the types of work and of personnel in Government Departments usually described as "statistical," however wide and inexact the current connotation of the word.

6. Excluding such specialists as actuaries and cost accountants, there is one broad and useful classification which can be made at the outset:

(a) "Descriptive" statistics, which cover the collection, summarization and interpretation of numerical material without reference to questions of sampling or the problems of representativeness associated with the theory of probability. The great bulk of departmental statistical work is "descriptive" in this sense. In its most primitive form it amounts to little more than recording and tabulating. The interpretation of the material, however, calls for that distinctive flair which is the characteristic of the true statistician. Such interpretation is work of a very high expert order. The tabulator and summarizer we shall refer to as a "statistical clerk." The interpreter may fairly claim to be called a "statistician." His theoretical equipment need not be very large—it is rare in this class of work even for such elementary functions as standard deviations or correlation coefficients to be required—but he must possess an expert knowledge of the limitations of his material, be able to draw sound logical conclusions from them and (what is of great importance in the Civil Service) to express those conclusions in a form which can be grasped by the layman.

(b) "Mathematical" statistics, which cover the more specialized theory capable of application to testing the significance of sampling enquiries, to various forms of scientific experiment and to a whole range of problems in which the Government as producer or user is interested in the control of quality, whether of human beings or of products of industry. In many such problems it is being widely realized that the scientific approach is in fact the statistical approach. The statistician engaged in this class of work must have a considerable knowledge of mathematics and a scientific mind. He also should possess the flair for figures of his "descriptive" colleague, and if he is to pull his weight in any organization his analytical skill in mathematics must be tempered with common sense and sound judgment. There is not (or ought not to be) any antagonism between the descriptive and the mathematical statistician; in fact some people are both. The broad distinction is similar to that between the general practitioner and the specialist in medicine, and it is from this angle that the distinction becomes important for our present purposes.

7. The remaining parts of the Memorandum deal with the position before 1939, with the important changes brought about since the outbreak of war, and with our recommendations for the organization of statistics in Government Departments after the war has ended.

## PART 2. THE PRE-WAR POSITION

*The collection of statistics*

8. Before the war each Department collected its own statistics. Frequently there was no statistical branch \* even in a major Department—there was, for example, none in the War Office or the Admiralty. In such Departments, and even in Departments where statistical branches did exist, it was the general practice for each branch to deal with the statistics required for its own work.

9. Furthermore, no Department possessed general powers to collect such statistics as it might require. The Registrar-General's Department had the duty of conducting the population census and of doing such current work as the recording of births and deaths. The Board of Trade conducted a Census of Production and the Ministry of Agriculture an annual Agricultural Census, both under statute. And, of course, the Revenue Departments had certain powers to require information necessary for the performance of their functions. But in all these cases the scope of the questions which might be asked was carefully limited and the legislation concerned seems to have been drafted with a view to protecting the individual against having a Department prying into his personal affairs. In pre-war days a favourite reply of a Minister to questions of statistical fact was "The information is not available," and if pressed to obtain it he would answer "I have no power to require a return on the lines suggested."

10. This was hardly the fault of Departments or of Ministers. The average citizen in this country was jealous of his private affairs and reluctant to disclose information about them. Before consenting to be cross-examined he required to be satisfied that his answers were needed for some specific purpose. There was not infrequently an active resistance on the part of the population to giving information gratuitously to Government Departments, and the latter could not be blamed if they kept their enquiries to the minimum. If a country gets the Government it deserves, one may say with equal truth that it also gets the statistics it deserves.

11. Thus the collection of statistics on a compulsory basis by Departments was kept within carefully defined bounds, and it cannot be said that the general population, as represented by Parliament, were anxious to exceed those bounds. Nor can it be said that Departments on the whole were anxious to initiate voluntary enquiries, although for many years enquiries into labour conditions have been made on a voluntary basis. To carry out any extensive work requires time, money and staff, all of which are denied to a Department unless it can show some necessary cause or the prospect of an immediate return. In the two or three years before the war, however, there were developments; for instance, the Ministry of Agriculture began in 1935 a five-year enquiry into the financial results of farming.

12. All this, however, is not to say that Departments did not acquire much statistical information in the course of their normal official work. This type of data arose, so to speak, as a by-product of administrative duties, and nearly every Department included a certain amount of numerical material among its official records. Some idea of the wealth and range of the information available can be gained from a glance through the *Guide to Current Official Statistics*

\* The word "branch" is here used in a general sense to denote any subsection of a Department, whether Division, Branch (properly so-called) or Section.

of the *United Kingdom*, though this refers only to published material and does not include the larger amount reposing in departmental files.

13. So far as collection is concerned, the principal features of this mass of data seem to have been:

(a) That most of it was collected for some special administrative purpose or as a consequence of some administrative duty, and not for its own sake. As a result it was frequently not in the form most suitable for statistical study.

(b) That it was acquired by branches concerned with administrative work and was therefore sometimes not properly recorded and summarized.

(c) That in consequence of the system of collection by individual branches there was in many cases very imperfect co-ordination even between branches of the same Department in the collection of the material.

14. The defects of this system are clear and will, we think, become even clearer as we proceed; and as our object is to suggest improvement, we naturally endeavour to bring the defects into prominence without dwelling on the advantages of the system. Perhaps, therefore, we had better say at this stage that the pre-war system possessed one feature which in our opinion ought to be preserved, namely, that the *collection* of statistical material should, where possible, be left to those Departments and to those branches of Departments whose administrative duties bring them into daily contact with the persons providing the information. In the collection of descriptive material there are so many concealed difficulties that it would be wasteful not to take advantage of the fund of experience acquired by administrative branches and the friendly relations which many of them build up with their clientele, if we may call it such. As we suggest later, the branches may require advice from a co-ordinating statistical branch in the formulation of enquiries and the treatment of results, but the extra-departmental contacts should, so far as possible, be left in their hands.

#### *Analysis of statistical material in Departments*

15. One of the defects of the system under which each branch was responsible for its own statistical records was that inadequate use was made of the information available. In some cases the summarization was of the most primitive kind and no attempt was made to correlate the information with material in other branches or other Departments. There was no obvious reason why it should be, and as a general rule officers were too busy to interest themselves in the affairs of other branches—and were likely to be discouraged if they did. The consequence was that in Departments which did not possess a statistical branch no systematic attempts were made to assemble and co-ordinate even such information as was already to hand. Not only were the data collected in an imperfect form but the maximum use was probably not made of such data as existed.

16. The position was materially better in the major Departments which had a statistical branch as such—the Board of Trade, the Ministry of Labour, the Ministry of Agriculture and the Ministry of Transport. Here the volume of statistical work laid on Departments by statute or by such duties as the preparation of reports to Parliament was sufficient to justify the existence of a statistical unit with a fairly large staff. Even in such cases a certain amount of statistical material was collected by other branches, but the existence of a separate statistical branch usually involved contacts with such other branches and must have

resulted in a general raising of the standards in them. This does not imply, however, that members of the statistical branches had a sort of roving commission to concern themselves with the statistical records of other branches.

17. In relatively few cases does there seem to have been any system under which the head of the statistical branch made periodic reports of his branch's work for the purpose of guiding policy. There were many departmental reports on the results of legislation and routine reports of facts; but many statistical sections seem to have regarded their duties as fulfilled if they provided summarized records of numerical data, without any attempt at interpretation. Perhaps we can put the point most clearly, if somewhat broadly, in this way: the work of statistical branches was to answer questions, not to ask them. They were to provide numerical facts required for pre-determined purposes, not to extract from their facts evidence of problems unsolved or desirable lines of enquiry unpursued.

18. There is no desire to undervalue the useful advisory work which was undoubtedly carried on by statistical branches, particularly in some of the major Departments. Our point is rather that the utilization of statistical material was imperfect and unsystematic, with the inevitable consequences of loss of information and efficiency. Generally speaking, we are of the opinion that in the pre-war period a good deal more could have been done by way of the analysis and interpretation of existing material and that such work, if carried out, could have been of great benefit to Departments and to Ministers.

#### *The staffing of Departments*

19. A further consequence of the system under which branches did their own statistical work was that, except in statistical branches, there were no statisticians, or even statistical clerks. The recording, tabulation and summarization in such cases fell to ordinary clerical officers or clerical assistants, and was supervised by Higher Executive Officers, Staff Officers or Principals. None of this staff had, except by accident, any statistical training and the consequence was that a good deal of the descriptive statistical work was carried out by staff who had no special qualifications for it. It does not follow that the work was badly done, because much of it was of the type which requires only accuracy and a limited arithmetical facility; nor can it fairly be inferred that the officers concerned were incapable of appreciating the statistical significance of their work or of interpreting it satisfactorily for their own purposes. We are, however, satisfied that sometimes at least the system tended to produce indifferently kept records, to favour the accidental concealment of useful information, and to predispose towards statistical inefficiency. It could hardly have been otherwise in branches whose members were unfamiliar with the rudiments of statistics and had no motive for acquiring even an elementary knowledge of the subject.

20. The staffing position in statistical branches also exhibited a number of unsatisfactory features. Almost universally the staffing of such branches was carried out on the same lines as that of other branches. The clerical work was performed by clerical assistants and clerical officers, the supervision by higher clerical or executive officers, and the head of the branch was nearly always of the executive grade, although in a few major Departments he was an administrative officer. We know of no case in the pre-war period where a statistical branch concerned with descriptive work employed a technical officer as statistician.

21. Now it may reasonably be argued that for descriptive work statisticians

are born, not made; that they are just as likely to be born in the executive or administrative grade as elsewhere; and that in a large Department there will almost certainly be a few men with the statistical flair who should gravitate to the statistical branch under the guidance of a far-sighted establishment. Certainly in the past there have appeared among the executive and administrative ranks very distinguished statisticians, many of whom have duly found their way into statistical work. But in our view it is profoundly unsatisfactory to rely on chance for the staffing of statistical branches, and in any case the system (if, indeed, it can be described as such) has grave drawbacks:

(a) In the first place, a member of the statistical branch, like other members of the clerical or executive grade, can be transferred to any other branch at any time. Frequently his only prospect of promotion is by such a transfer. He therefore works under the knowledge that statistics form a transient interest in his official career and has no incentive to study the subject in any detail. Moreover, there frequently exists an impression that experience in the statistical branch only is insufficient to qualify for promotion.

(b) Secondly, when a vacancy occurs in a statistical branch, the head of the branch has to take such officers as are available and, as the vacancy has generally to be filled by promotion, he usually has a very restricted field of choice among those regarded as qualified. It is therefore far from certain that he will be able to recruit a man with statistical ability, still less with statistical knowledge. There is no reasonable guarantee, when the officers of a Department stand on an equal footing and promotion proceeds by seniority (or general non-statistical ability), that the statistical branch will be properly staffed. This is true even of large Departments but much more so of smaller Departments, where the numbers involved are insufficient to make it likely that somewhere in the Department there will be a man with statistical ability who can be released for transfer.

(c) The constant transfer of personnel involved a continual loss of experience and the continued necessity of training newcomers. This, of course, is true of any branch, but in statistical work the loss of an experienced man is probably more serious than in other branches. Statistical experience is acquired more slowly than normal administrative experience and a really good statistician takes years to mature. It is not surprising, therefore, that there is some reluctance among heads of branches to release their experienced men, with the consequence that experience may be a definite handicap to promotion.

22. We may add one other feature of the pre-war position in regard to personnel. It is not an inherent defect of the system like those already referred to, but was in fact a drawback as that system was operated. There was never any statistical training for members of a statistical branch even after they had joined that branch. Where any choice was exercised at all, entrants were usually selected on their school or university mathematical record together with their performance in entrance examinations. (It seems to have been shown by experience that mathematical ability was a sufficient, though not a necessary, quality for success in statistical work.) But once an entrant had joined a branch he received only the ordinary training in branch work and statistical training as such was left to his personal interest. In certain cases, the head of the



branch encouraged his staff to take a wider statistical interest and to read the elementary literature on the subject, but this seems to have been exceptional.

23. The position of the head of the statistical branch merits special mention. He was, as a rule, an officer recruited to the Service through the Executive or Administrative Examinations, which purport to select men for their general ability and ignore specific factors as far as they can. It was most unlikely that he had any statistical training or knowledge before entering the Service and quite probable that he acquired none after entrance except by actually working in the statistical branch. Notwithstanding this fact, the heads of branches in a number of the major Departments were accomplished statisticians. But only in some, not in all. It was quite possible, and did in fact occur from time to time, that when the headship of the statistical branch fell vacant, a man with no knowledge of and little interest in the work was appointed. This was fatal to the standards of the branch and the mere fact that it could happen constitutes a serious defect in the system. The structure of the Civil Service is such that it would be a rare event for any Department to fill such a vacancy from some other Department.

24. Apart from this, the position of the head of the branch was not altogether satisfactory. He was an executive or administrative officer and consequently his only prospect of promotion was to a higher post probably dissociated from statistical work. If he did his job exceptionally well he was likely to remain doing it for the rest of his official career simply because it would have been an obvious waste of talent to move him. If he merely handled it capably as a piece of routine administration, the work of the branch, which depends very much on the inspiration of its head, would suffer. The only other possibility was one of the rarest events known in statistics, the upgrading of a statistical post in the Civil Service.

25. Most of the foregoing applies only to descriptive statistics. Before the war very few Departments felt any need for statisticians with a scientific training. On the rare occasions when a Department felt in need of advice the practice was to consult an expert either formally (*e.g.*, by the Ministry of Health, through the Medical Research Council) or entirely informally or by the appointment of a Committee comprising experts from outside the Department. This practice was also followed, to an even more limited extent, in descriptive work when important theoretical points were involved, particularly in sampling (*e.g.*, by the Ministry of Labour in the Family Budget Enquiry of 1938). We have used the word "practice" in this connection, though it does not seem that there was any generally accepted rule of procedure or even that Departments were conscious when outside advice would be useful to them. We return to this matter in Part 4.

#### *Liaison between Departments*

26. As the result of a petition of the Society in 1919 a Permanent Consultative Committee on Official Statistics was appointed to co-ordinate departmental statistics. It comprised representatives of the major Departments under the chairmanship of Sir Alfred Watson, the Government Actuary, and later of Sir Frederick Leith-Ross. It was unwieldy, and had no initiatory powers, being able only to consider matters referred to it by Departments. We think it fair to say that the Committee exercised little influence on departmental practice and that by the outbreak of war it was moribund. Its main work, so far as we know, was the not very successful attempt to secure co-ordination in the industrial and occupational classifications used by various Departments. *The Guide to Current*

*Official Statistics of the United Kingdom*, which was recommended by the Treasury Committee that considered the Society's petition and which was undoubtedly useful, was compiled by the Secretary to the Committee, but this could equally well have been done by the Board of Trade as the Department responsible for the preparation of the Statistical Abstract.

27. So far as is known, no other formal measures were taken to co-ordinate the statistical work of Departments either officially or semi-officially, except in one or two trivial instances. The only co-ordinating influences at work were the personal contacts between members of different Departments (favoured, we are pleased to say, by their meetings on the occasions of the Society) and the difficulties experienced when Ministers were briefed in different manners on the same data by their respective advisers. These factors were not nearly powerful enough to maintain a complete and efficient liaison.

28. It may seem rather surprising that Departments should not have felt the necessity for co-ordinating the machinery for producing facts, whatever their differences on matters of policy may have been. It should have been important to avoid the danger of conflicting advice being given on account of the use of different data, which had not been compared or agreed beforehand.

#### *Summary of the pre-war position*

29. A general survey of departmental statistics before the war gives the impression of very wide differences in practice and performance. In only a few of the major Departments was there any statistical organization which can be regarded as adequate. In the others the limited needs of the Department seem to have been met by improvisation. There was little liaison between Departments. The system under which each Department, and in many cases each branch of each Department, was responsible for the collection and handling of its own statistical material, though containing useful features, tended to result in inadequate use being made of available material and in dissipation of effort. The staffing of Departments was unsatisfactory in regard to the training of personnel, and in certain respects to their status. Nowhere was a knowledge of statistical theory regarded as a necessary qualification for employment in statistical work and the technical post of "statistician" was practically unrecognized.

### PART 3. WAR-TIME DEVELOPMENTS

#### *Shortage of statisticians at the outbreak of war*

30. Almost immediately after the war broke out the strain thrown on the administrative machine brought into prominence its chief defects in statistical organization. There was an instant demand for statisticians of both descriptive and mathematical types and there soon became evident the acute shortage in qualified personnel which has continued ever since. Existing Departments rapidly expanded in certain directions and began to feel the need for expert statistical help; but the greatest demands came from the new Ministries—Food, Supply, Aircraft Production, and Economic Warfare particularly.

31. One of the results of this is that many persons are now employed as "statisticians" in Government Departments who would not normally be able to find employment as such. The shortage has been so great that wherever a point could be stretched to include a person within the definition of statistician,

it has been done. This is not altogether good for the reputation of genuine statisticians, but we do not wish to pursue the point further.

32. For obvious reasons we cannot go into detail in describing the new statistical work which has fallen on Government Departments during the war, but there are a few features on which general comment may be helpful:

(a) Supply and transport problems have made it absolutely necessary to keep detailed and intricate statistics of commodities and services which, before the war, were scarcely within the purview of State Departments at all. In many cases new statistical units have had to be created to meet the demand for information.

(b) The shortage of statistical clerks has led to the introduction of a scheme of training for junior members of the Civil Service. Courses of eight weeks' duration are being given by the London School of Economics at Cambridge and, limited as they are, provide a most useful start to a statistical career in the Service.

(c) The developments are by no means confined to descriptive or to economic statistics. The complexities of modern warfare have led to a welcome, though slow, recognition of the importance of the scientific outlook in the fields of production, of development and of operational research. When quality in the widest sense, as distinct from quantity, becomes a subject for scientific investigation it is soon found that the methods of attack must be those of the mathematical statistician, for only with these is it possible to grasp the implications of the inherent variation between individual units. This is true whether the unit be a member of the Forces and the problem that of selection and training of man-power, or a component part of the wing structure of an aircraft, or the mechanism of the time-fuse of a shell, or is an even more complex unit consisting of a humanly operated gun with an elaborate system of mechanical fire-control direction behind it. To meet this demand no adequate supply of mathematically trained statisticians existed and the gap had to be filled in the majority of cases by the scientists on the job—mathematicians, physicists, physiologists—setting to and learning for themselves the elements of probability and error theory.

#### *The Central Statistical Office*

33. Once the country was firmly on a war footing it was realized that the Central Government could not adequately direct the war effort without accurate and up-to-date information on a wide range of subjects. This in turn brought into prominence the weakness in regard to inter-departmental liaison to which we have referred above; and even if that liaison had been adequate in pre-war days it would have had to be very greatly strengthened. The close relationship between such diverse matters as shipping and agriculture, aircraft production and rubber stocks, food rationing and recruiting programmes—to mention only a few—meant that there was a keen necessity for some body which could bring all the statistical information together and reduce it to a coherent and comprehensible form for the Government's use. For this purpose a Central Statistical Office was established within the Offices of the War Cabinet in 1941. Its main functions, we understand, were:

(a) to ensure that the requisite figures should be collected by Government Departments in a systematic manner;

(b) to arrange, when necessary, for inter-departmental discussions on all statistical questions;

(c) to maintain day-to-day liaison between the statistical branches of Departments and with the Central Executive, so that agreed figures could be accepted and used without question in inter-departmental discussions;

(d) to compile statistical information for the War Cabinet and its Committees;

(e) to act as a central organization for the circulation of statistical information between Departments.

34. In our view the formation of a Central Office is a development of great significance and the principle of providing a co-ordinating body of this kind is one which we cordially welcome. There are many matters in which Ministerial decisions have to be based on a balance of interests represented by different Departments—for instance, the question whether shipping space shall be allocated to food or to munitions, or the question whether a particular class of artisan is more useful in industry than in the Services—and it is almost impossible for a complete objective presentation of the statistical facts to be given except by a body such as the Central Statistical Office, which has no departmental obligations. Although the Office was called into being by the war there is clearly a case to be examined as to its continuance in peace time, and we return to this matter in Part 4.

#### *Co-ordination of mathematical statistical work*

35. The Central Statistical Office has been concerned almost exclusively with descriptive statistics. In certain fields, such as those of quality control, there have been big developments in the application of mathematical statistics, notably in the Supply and Service Departments. So far as we are aware no official co-ordination of this work exists. But the feeling among the statisticians engaged in such work that some kind of organization should be formed has been so strong that they have, in effect, founded their own under the aegis of our Society. A Section of the Society has been formed to promote the study and interchange of experience of statistical methods in industry, and though membership is not restricted to Government servants, many members do in fact belong to Supply and Service Departments. We understand that, within the limits imposed by considerations of secrecy, the discussions at the meetings of this Section are proving very useful in enabling members of different Departments to keep in touch with one another's work; and no doubt the personal contacts made at the meetings are equally valuable in enabling private notes to be compared on topics which are unsuitable for public discussion.

#### *Mechanization*

36. Before the war the use of mechanical aids to computation and statistical analysis was not so general as it should have been. A great deal of work was done by hand which could have been done more accurately and more expeditiously by machine, particularly if there had been effective co-ordination between branches or Departments in the use of the machinery. The pressure on manpower during the war has done much to break down resistance to mechanical aids and we are glad to observe that many improvements have been brought about in the last three years. For example, the annual agricultural census has

been mechanized, a fact which not only improves war-time statistics but will in future provide a mine of information for research on agricultural matters.

*Change in public attitude towards statistics*

37. In pre-war days the average citizen's attitude towards statistics was that of one of O. Henry's characters, who defined it as "the lowest grade of information known to exist." A good many Civil Servants shared this view, and a man with a statistical reputation in the Service was not always *persona grata* with the Higher Administration—at the best he was considered a harmless drudge, at the worst a nuisance who was apt to produce figures at the wrong moment to weaken a promising line of argument. There were, of course, many exceptions to this generalization, but we feel that on the whole the attitude of both the public and non-statistical branches of Departments was unfavourable to statistics and statisticians.

38. There has undoubtedly been a decided change for the better since the outbreak of war. The statistician is now sought after as he never was in peace time, his advice taken and respected in quite a new way. It is, we think, now generally recognized that a war must be run on facts, and that the interpretation of numerical facts is an expert accomplishment. Furthermore, there appears to have been a significant shift of emphasis. Statistics are no longer a by-product of administration or a useful index of the results of a course of action. They are a necessary pre-requisite in framing plans and courses of action. The statistician is now not concerned mainly with post-mortems but with preventing post-mortems.

39. It would appear that at the same time there has been a change in the public attitude towards the rendering of returns to State Departments. A good deal is still heard about the nuisances of filling up forms, but so far as we can discern the grumbles are against the complications of the forms, not the principle that returns are necessary for the adequate conduct of Government. The primary reason for the change is undoubtedly that those who complete the forms can see that there is a definite purpose behind them and in many cases they must complete the form to obtain some advantage. Time will show whether a change of heart has really occurred or whether it is merely a superficial change that will cease when conditions return to normal. We have referred in Part 2 to the public resistance to the return of statistical information to the Government and its effect on Government statistics. If in fact the general public has now come round to a more reasonable view or can be brought round by education and instruction, one of the basic difficulties of statistical reform has been removed.

*Summary of war-time developments*

40. The effect of the war has been almost universally beneficial to statistics. The shortage of trained statisticians emphasizes the importance of the contributions they can make to the service of the State in the field of both descriptive and mathematical statistics. Some degree of internal training of the employees of statistical branches has been initiated. Co-ordinating machinery in the shape of the Central Statistical Office has been set up. Increased use is being made of scientific aids to numerical work. Finally, there are signs that the public and departmental attitude towards statistics is undergoing a fundamental change for the better.

## PART 4. REQUIREMENTS FOR THE POST-WAR PERIOD

*A fundamental assumption*

41. Our consideration of alternative schemes of post-war organization has proceeded on the basis of one important assumption, namely, that the Government's demand for comprehensive statistical information during war-time will continue into the post-war period of reconstruction and beyond. It seems to us an inevitable social development that the State will intervene on an increasing scale in the life of the community in future years, and therefore that an increasing amount of statistical information will have to be collected for Ministerial guidance. Even to-day it is possible to predict with some confidence that greatly increased information will be necessary to formulate plans for reconstruction and social improvement. In this connection we note that Sir William Beveridge, in his recent Report, stresses the importance of an adequate expert statistical staff in the Ministry which he proposes should be set up to deal with Social Insurance. It is easy to see that national or international regulation of exchange, currency and trade will require complete and accurate statistical information. The list of possible requirements might be extended almost indefinitely. We therefore take it as axiomatic that in future statistics will form an important constituent of the work of Government Departments; and we have accordingly considered the merits and demerits of various possible schemes of organization to enable that statistical work to be carried out efficiently.

*The formation of statistical units*

42. In the first place we consider that every major Government Department should have a statistical branch under the direction of an officer of the administrative grade. We recommend that the work of the branch should not include other duties of an administrative character which might interfere with the statistical work. Experience has shown that where a branch has mixed duties the statistical side is likely to be pushed into second place, notably on grounds of urgency.

43. Where the work of a Department is not sufficient to justify the formation of a statistical branch (as may happen in many of the minor Departments), we suggest either the formation of a smaller unit or the assumption by the major Department to which the minor Department is affiliated of the statistical work of the latter. No doubt special circumstances will require special measures, but so far as practicable the principle should be maintained that the statistical work is carried out under the supervision of a full statistical branch—or of the Central Statistical Office.

44. We do not think it necessary to disturb the system under which non-statistical branches collect their own statistics, but for reasons given above we think that work of this kind should be co-ordinated within the Department. In some cases this may be done by having an officer of the statistical branch working in the branch concerned (as, for instance, has been done in the Ministry of Food). In other cases nothing more is necessary than an understanding between the heads of the branches concerned. In any event it would have to be made clear that the statistical branch was entitled to express an opinion on the way in which other branches handled their material and to make recommendations for improvement. We feel sure that non-statistical branches would find no objection to this and would soon appreciate the assistance received in the organization of their records,

*Staffing of statistical units*

45. So far as the staffing of Departments is concerned, the requirements of the situation would in our view be met on the following lines:

(a) There should be a certain number of definitely statistical appointments carrying stipends comparable with those of the more senior officers in the administrative grade.

(b) The senior staff of statistical departments might be recruited by any of three methods:

(i) By transfer from the administrative grade, at any stage of a man's career, of an individual who has inclination and aptitude for statistical work.

(ii) By selection, on the basis of interview, recommendation, and record, of technically qualified statisticians, with an age limit a year or two higher than that allowed for the Class I examination. The ideal course would be for a man to have taken mathematics, followed by a course in statistics and either economics or other appropriate subjects, and then by a year of research and investigation either at the University or in field work or with a business organisation. Those thus recruited should after appointment have exactly the same status and stipend as Civil Servants who have entered regularly through the Class I examination and, provided they are suitable, be assimilated to the administrative grade. Those not so assimilated would remain technical statisticians.

(iii) In very exceptional circumstances, through the quasi-temporary appointment or seconding of more senior persons who have made their name in statistical work outside the Service.

(c) An endeavour should be made to post selected junior administrative officers to the statistical branch during part of their career, which would automatically ensure that at some later date there is likely to be a suitable successor to the head of the branch. Junior officers should be encouraged to take a course in statistics if they have not already studied the subject; and when qualified in this way we think they should be regarded as available for promotion to the position of Principal in any Department requiring an officer of that grade for a statistical branch. It should be a *sine qua non* that the head of a statistical branch should be qualified at least by having worked for some time in a statistical branch and by having taken a course in elementary statistics, and the combination of such knowledge with administrative ability in the heads of branches should raise appreciably the general standard of the statistical service of the State. Moreover, even for officers whose subsequent careers lie outside the statistical branch, their service there would provide a valuable constituent in their administrative training.

(d) In a number of the major Departments, there may be a case for the establishment of a statistical officer with technical qualifications. In some cases statistical officers have been appointed in war-time and we recommend that all Departments should consider whether there is not scope for a full-time technical statistician \* in the interpretation and analysis of their

\* By a technical statistician we mean a man with a thorough knowledge of statistical technique in the appropriate field. He need not necessarily be a mathematical statistician, though frequently he will be.

statistics. We do not go so far as to recommend that a technical post of statistician be created in every major Department, since the volume of work may not be sufficient to afford full employment to such an officer, and Departments may prefer to call on the aid of the Central Statistical Office in the manner referred to later. But we do recommend that such Departments as can suitably employ technical statisticians should be allowed to have them, and that all Departments should be able to call on the services of a technical statistician when necessary, not only for advice but for the actual performance of pieces of work.

(e) Recruitment of supervisory staff should be from officers with a statistical or mathematical record, and if no such officers are available in one Department transfer should be made from others. The point here is that the head of the branch should be relieved from the necessity of having to accept unsuitable staff because nothing better was available on his Department's own establishment. Junior staff should have obtained good marks in mathematics in their entrance examination.

(f) The system of giving free courses in elementary statistics to selected members of a statistical branch should be continued and extended to all Departments. Members who wished to proceed to advanced courses should be given every encouragement and facility to do so.

46. The creation of a grade of technical statistician would raise some difficulties which we have carefully considered. That there is full scope for such a man in some Departments, we do not doubt. It is, however, necessary to consider how he should be recruited, and what should be his prospects of promotion.

As regards recruitment, par. 45 (b) (ii) and (iii) deal with the recruitment of technical statisticians from outside the Service. But persons already in statistical branches should not be debarred from attaining this status, provided they have the necessary qualifications. If any body were constituted to confer professional qualifications on statisticians the existing civil servant or the technical statistician otherwise recruited would naturally be expected to be so qualified.

47. The question of promotion is more difficult. There is no real reason why a technical officer should not be appointed to an administrative post and continue up the administrative ladder in the ordinary way. As a general rule, however, a technical officer does not gain much administrative experience in the Service and is therefore at a disadvantage in competing for administrative posts. Statisticians frequently develop considerable administrative powers if given a chance to exercise them and administrators certainly benefit from statistical training. Before the war, however, there was a great gulf fixed between administrative and technical posts which was crossed only in very exceptional circumstances. In consequence we do not regard it as altogether satisfactory to leave the technical statistician with no other prospect of advancement than transfer to the administrative grade. It is at this point that the Central Statistical Office becomes relevant, and we return to the question below in connection with the future functions of that Office.

48. It may be questioned whether, in view of the staff difficulties, there is much reason for appointing a technical statistician in Departments concerned purely with descriptive statistical work. On the whole we think the case is a strong one, for the following reasons:



(a) Even in descriptive work there arise problems which are best dealt with by a technical expert, particularly in the sampling sphere, and the number of such problems may be expected to increase as time goes on.

(b) An administrative officer, though he may possess the knowledge to deal with such problems in the main, rarely has the time to work at them. He is always liable to interruption, and current day-to-day work prevents him from giving his whole attention to theoretical points. A technical man is insulated from these disturbances to a great extent.

(c) A technical officer is more likely, in virtue of his training and experience, to be able to detect weaknesses in departmental methods and to find remedies for them.

(d) If, as may be expected, the practice grows of analysing and interpreting departmental records for the purposes of factual reports and suggesting courses of administrative action, a certain amount of internal research may be required; and the appropriate officer to do it is the technical man.

In fact, the case for a technical statistician is very much the same as that for other technical posts in the Service. The proper utilization of statistical material requires special qualifications which the administrative head of the branch in general either does not possess, or if he does, cannot exercise in virtue of his pre-occupation with administrative work.

49. If the above recommendations were accepted there would automatically come about a greater degree of uniformity of status as between different Departments. Before the war the heterogeneity, even among such statistical officers as existed, was very great. In the Board of Inland Revenue the Director of Statistics and Intelligence was a Principal Assistant Secretary; in the Board of Trade, the Ministry of Labour and the Ministry of Agriculture the head of the Statistical Division was an Assistant Secretary or of an equivalent grade. The fixed salary of the Controller of the Customs Statistical Office exceeded the minimum of an Assistant Secretary and the salary scale of the Statistical Officer of the General Register Office overlapped with the Assistant Secretary scale, as also did that of the Statistical Officer of the Ministry of Health. There were many similar anomalies in lower grades.

50. Outside Government circles it has not infrequently happened in the past twenty years or so that men starting originally as statisticians have been found to attain such mastery of the subject-matter dealt with that they have become invaluable as administrators in the subject. If the statistician in Government Service is to be of the greatest possible use to his country, he should not be barred from administrative posts in which the knowledge he has acquired in studying the statistics of a subject may be of great value and render him, if he is not devoid of the ordinary characteristics of an administrator, a particularly suitable man for such work. A statistician, by introducing a few numerical indications into an administrative problem, may often open up a method of solution which has hitherto appeared hidden. We put in a strong plea, accordingly, for a broad view to be taken of the duties of statisticians in the Government service, recognizing their great potential value if they happen to combine some administrative flair with their quantitative outlook.

51. An aspect of Government statistical returns, to which, in our opinion, too little attention has been given, is that of ensuring the accuracy of the data on

which they are based. In the present war it has been found that a fair proportion of the returns made by certain manufacturers contained errors, in spite of the fact that the returns were certified as accurate by chartered or incorporated accountants. Some knowledge of the subject-matter with which the statistics deal, sufficient to enable the statistical officer to have a suspicion that the figures put before him require further scrutiny, seems essential if confidence is to be placed in the conclusions which may subsequently be drawn from those statistics or any proposals based on them. Every possible opportunity should be taken, therefore, to enable statistical officers to become as familiar as possible with the subjects of which they handle the statistics.

#### *Co-ordinating machinery*

52. In our view it is of paramount importance that the statistical work of Government Departments should be firmly co-ordinated. "Co-ordination" in this connection may have several meanings, as referring to the output of Departments, their practice or the status of their personnel, and in all three respects we consider that some action is necessary.

53. We have considered various alternatives. The first was a continuance in some form or other of the existing Permanent Consultative Committee on Official Statistics. That is far too unwieldy a body as at present constituted to co-ordinate the activities of Departments with divergent views, and even if it had an executive committee comprising only a small number of members we question whether it would function satisfactorily.

Another alternative considered was a body on the lines of the Economic Advisory Council, composed of eminent statisticians from outside the Civil Service, which could advise the Cabinet or Departments on matters affecting the interests of more than one Department. Without a considerable staff composed of civil servants, it would not be in any better position than the executive committee considered above. It would suffer from the disadvantage of not having detailed knowledge of the subject-matter being considered, but would, on the other hand, have the advantage of being able to take a view free from departmental bias.

The third alternative, and indeed the only one that we consider practicable, is a Central Statistical Office. The existence of a Central Statistical Office at the present time and the necessity for that Office to continue in existence for some time after the end of the war may render it more easily incorporated into the future Government organization than if it had to be set up afresh, as was recommended by the Society after the last war. It is of prime importance that the head of the Office should be selected for his personal as well as his statistical qualifications. He would occupy a post of the greatest importance and responsibility, and in view of the proposed functions of the Office in regard to co-ordination he should not only command the respect of statisticians inside and outside the Service, but be able to maintain close and cordial relations with the many Departments with whom he would come in contact. Much would depend on his initiative, tact and vigour, and we think that these qualities, rather than statistical eminence, should determine his selection.

54. One of the important functions of the Central Statistical Office would be to standardize the methods of different Departments (e.g., in regard to definitions, classifications and time periods) and to co-ordinate their work in order to ensure comparability, the avoidance of duplication and the collection

of adequate material where required for the Central Government. The problem is to ensure that the co-ordination will be really effective and that Departments shall work harmoniously as part of a national statistical service without encroaching more than is necessary on individual freedom of action. It would assist in this direction if the Central Statistical Office were advised by a small Committee of not more than, say, six or eight members selected from among the heads of statistical branches in the major Departments for their outstanding statistical qualifications. The same Departments would not invariably be represented, and vacancies should be filled on nomination by the remaining members. The Chairman of the Committee should be the head of the Central Statistical Office, and that Office should be under an obligation to consult the Committee on all important questions. Probably regular meetings of the Committee would be advantageous in keeping the members in touch with current problems and in touch also with one another. To make the Committee as effective as possible we recommend that it should be empowered to initiate subjects for discussion, and to issue reports on statistical matters which do not fall within the province of any single Department. We think that in this way the Committee would carry great weight and its decisions would generally be acceptable to all parties concerned. In the event, however, of objection being raised by any Department, there should, we think, be suitable machinery for referring the matter at issue to an appropriate Committee of the Cabinet.

55. We contemplate that there will be need for an Economic Section of the Cabinet after the war and that the Central Statistical Office will form a parallel unit. In this capacity it would have the primary duty of compiling statistical information for the Cabinet and its Committees on subjects where the interests of more than one Department are concerned.

Though there may be divergence of views as to the detailed post-war organization of the Central Statistical Office, the following principles should, in our view, be observed in reorganizing the Office after the war:

(a) It should be no part of the duty of that Office to relieve Departments of their responsibility for collecting and compiling statistical data. There is no suggestion that such work should be brought together under one enormous unit.

(b) The Office should be divorced as far as possible from routine analysis and from administration.

(c) It should be charged with the duty of preparing statistics required by the Government, such as the Budget White Paper, or by such bodies as Royal Commissions and special Committees appointed by the Government.

(d) It should ensure that as much statistical material as possible is made available to the public and that all Government statistics are issued with the minimum of delay.

(e) It should endeavour to fill gaps in statistical information by advising Departments on the desirability of certain lines of enquiry.

(f) It should undertake research work or loan staff to assist other Departments in undertaking such work.

(g) It should act generally as a co-ordinating body.

(h) It should be responsible for the issue of the *Statistical Abstract for the United Kingdom* and the *Guide to Current Official Statistics*.

(i) It should also be responsible for the publication of a monthly bulletin of statistics on the lines of the *Survey of Current Business* issued by the United States Department of Commerce.

56. The Central Statistical Office would not be a suitable Office for the direct appointment of an administrative officer on entering the Civil Service, as it is specialized, but experience in that Office would be of considerable advantage to any officer who was looking forward to becoming the head of a statistical branch; and if there are not sufficient Departments with facilities for training such officers, direct recruitment may be necessary, the officer being transferred to another Department after about two years. The staff of the Office would mostly comprise persons with a statistical training before entering the Service or who had acquired qualifications after entry, and the Office would thus provide an avenue of promotion for persons in other Departments desirous of following a statistical career.

Where the need of a Department for an expert statistician was not permanent, or was seasonal, it would be possible for the Central Office to station a man in the Department for a time, thus providing the Department with assistance as well as giving one of its members valuable experience. The transfer of personnel might thus be in either direction, from Central Office to Department or vice versa. An organization of this kind would do much to ensure uniformity of practice and status between departmental statisticians, as well as providing valuable elements of liaison.

57. Since the bulk of Government statistics is descriptive, and is likely to remain so, the organization suggested above refers in the main to descriptive work. We do not, for example, suggest that the major Departments will necessarily require a permanent expert on such matters as the design and analysis of experiments on quality control, though we hope that the possibility of increased scope for scientifically trained minds in such Departments will not be overlooked. There are certainly Departments which will occasionally need scientific assistance and, so far as we can judge, in some of them, for example the Service Departments, the volume of work will be sufficient to justify the employment of a full-time mathematical statistician. When the Department can establish a case for such a man we would recommend that a suitable post be established. A more difficult problem is to meet the requirements of those Departments whose need for mathematical statisticians is not sufficient to justify the employment of a full-time officer.

58. We suggest that the situation in which there is a casual demand from non-scientific Departments for assistance from a mathematical statistician may be met by one or more of the following three measures:

(a) By the employment of a few "mathematical specialists" by the Central Statistical Office or the Department of Scientific and Industrial Research who can be seconded to Departments for *ad hoc* jobs or advisory work. A system of this kind works quite well for mechanical work in the Service, there being a Machinery Branch in the Treasury which acts as adviser to all Departments. On the other hand, it would be important to ensure that the interests of the mathematical statisticians were not submerged in those of the other and more numerous officers of the Central Office.

(b) By the formation of an advisory Panel of mathematical statisticians whose advice can be sought on recondite matters beyond the capacity of the

officers employed under (a). This Panel would, so to speak, be a board of consultant specialists. Its services would, of course, be available to scientific as well as to non-scientific Departments, and it might also include members whose advice would be useful in some of the aspects of "descriptive" work.

(c) By the interchange of expert personnel between industry and the Service. We should, for example, welcome a system under which a particular man with specialized attainments and experience suitable for a special job of work could be seconded or transferred from industrial to Civil Service employment or vice versa. Such an interchange, we admit, would be something new in the Service organization in this country (though it appears to be common in the United States) and raises some wide issues, *e.g.*, in regard to pension rights, on which we are not competent to express an opinion. We accordingly content ourselves with recommending the possibility for serious consideration.

59. It is one thing to set up a co-ordinating machinery and an advisory panel. It is quite another thing to get Departments to call in an adviser at the right time. There is a danger that statistical branches may not be conscious when advice and guidance are needed, or that the specialist may not be called in until it is too late. It is obviously impossible to coerce Departments in a matter of this kind. We think the difficulty, if it arises, will be gradually solved over a period of years by the education of administrative officers and judicious coaching by the Central Office and the Co-ordinating Committee. Under the system we propose, Departments would be brought far more closely into contact with statistical work than in the past; and once the benefits of statistical advice and help had been experienced, little more would be needed to induce them to take advantage of the consultative machinery provided.

60. With regard to mechanization, we suggest that there should be a special branch of the Central Statistical Office or of some other Government Department, whose duty it would be to keep in touch with developments in all parts of the world and to consider the suitability of machines for Government purposes and suggest improvements and adaptations. With this background and knowledge it should be an important part of their duties to advise other Departments about mechanization and about keeping absolutely up to date with the most important methods.

#### *Special position of certain Departments*

61. Nothing has been said above about the position of the Foreign Office, Dominions Office, India Office and Colonial Office. They are themselves not directly responsible for the collection of any statistics, but they need information which has an economic or political bearing in respect of the countries with which they are concerned. The pre-war position was that reports on the commercial, financial, industrial and economic conditions in practically all countries were obtained from Trade Commissioners, Commercial Diplomatic Officers and Consular Officers, but the reports were not published at regular intervals—the latest one on France, for example, was dated June 1934. All the reports received were naturally not published, and we understand that in fact annual reports were made in respect of the more important countries. We recommend that reports should be published for important countries at least every two years, and that,

in general, reports about all countries should be more up to date than in the past.

62. The Board of Trade obtained all important publications concerning the trade and other economic statistics of all British and foreign countries, and much of this information was also received by the Department of Overseas Trade. The Foreign Office may have no need of a statistical branch; any statistical work on these publications could continue to be done by the Board of Trade. As regards the Dominions Office and India Office, they receive all statistical publications of the countries with which they are concerned, supplemented by reports from the Trade Commissioners. In the India Office there is probably greater need for a full statistical branch than in the Dominions Office, in view of the control exercised over Indian affairs by the Home Government. The Colonial Office published annual reports on the various Colonies, and also a comprehensive *Economic Survey of the Colonial Empire*. While the latter is not necessary as an annual publication, and the statistics in it are not so up to date or comprehensive as those in the *Statistical Abstract for the British Empire* published by the Board of Trade, it would be useful to have a review of this kind every two or three years. The Colonial Office, should, in our view, have a statistical branch, but the responsibility for co-ordinating the trade statistics of the various Colonies can well remain with the Board of Trade in view of their experience in dealing with all trade statistics. The co-ordination of all statistics within the Empire is most important and we should like to see more frequent opportunities afforded for statistical conferences.

#### SUMMARY

63. The pre-war position is summarized in paragraph 29 and the war-time developments in paragraph 40.

The following are our recommendations:

(a) Every major Department should have a statistical branch under the direction of an administrative officer (para. 42); and minor Departments should either have a smaller unit or work under the guidance of the statistical branch in a major Department or of the Central Statistical Office (para. 43).

(b) The collection of data outside Departments should be left, as at present, to the branches whose administrative duties bring them into contact with the persons supplying the information; but co-ordination is required within Departments (para. 44).

(c) Certain statistical posts should be of grades equivalent to that of the more senior administrative officers (para. 45 (a)).

(d) Recruitment of the administrative personnel of statistical branches should be from persons with mathematical or statistical qualifications, and transfer between Departments should be permitted where necessary (para. 45 (b)).

(e) An endeavour should be made to post selected junior administrative officers to the statistical branch as part of their training (para. 45 (c)).

(f) Technical posts of statistician should be created where Departments consider them necessary (para. 45 (d)).

(g) Full opportunity should be given for a technical statistician who

showed administrative ability to be transferred to the administrative grade (para. 50).

(h) The system of giving free courses in statistics to selected members of statistical branches should be extended and facilities given for advanced study (para. 45 (f)).

(i) Opportunity should be given for members of statistical branches to become familiar with the practical aspects of the matters with the statistics of which they are dealing (para. 51).

(j) Firm co-ordination of the statistical work of different Departments is necessary. This may best be effected by a Central Statistical Office acting with a small Committee selected from among the heads of statistical branches in the major Departments (paras. 52-54).

(k) The Committee should be small, should fill its own vacancies, should be empowered to initiate subjects for discussion, and to issue reports on statistical matters not falling within the province of any one Department. Its decisions should be binding on Departments, subject, on major matters, to Cabinet authority (para. 54).

(l) The Central Statistical Office should be relieved of routine analysis and administration, should, *inter alia*, undertake research work, should act generally as a co-ordinating body, should compile statistical information required for the Cabinet and its Committees on subjects where the interests of more than one Department are concerned and should secure prompt and full publication of Government statistics (para. 55).

(m) There should be transfer of personnel from Departments to the Central Office and vice versa, and the staff of the latter should be available for rendering assistance to Departments (para. 56).

(n) Certain Departments may require the services of a mathematical statistician and should be provided with those services either by the appointment of a full-time officer, the loan of a suitable officer from the Central Statistical Office or the Department of Scientific and Industrial Research, the use of an advisory panel of experts, or perhaps by engaging a man specially from industry for a time (paras. 58 and 59).

(o) The Central Statistical Office or some other Government organization should ensure that the most effective use is made of modern machine methods (para. 60).

(p) The position of the Foreign and Colonial Offices, the Dominions Office and the India Office requires special consideration; in the Colonial Office, at least, a statistical branch is necessary (paras. 61 and 62).

On behalf of the Council,

E. C. SNOW,  
*President.*

L. ISSERLIS,  
A. BRADFORD HILL, } *Hon. Secretaries.*  
C. OSWALD GEORGE }

## THE VOLUME OF INDUSTRIAL PRODUCTION

By A. L. BOWLEY

AFTER reading Mr. Leak's note on this subject in the *Journal* (1943, Part I), I am doubtful whether he has realized the purpose of the section of *Studies in the National Income* which he criticizes or the implications of the method of obtaining an index of production used in the Census of Production Volumes.

The main object in the book was to obtain a double measurement of production and real income—namely, one weighted by the relative importance of classes of goods and services at the initial period, the other at the final or at least a later date. The two measurements are the correlatives of Paasche's and Laspeyre's index-numbers of price. It is, I think, commonly admitted that these measurements have equal claims for their general objective, though for particular purposes one or the other may be preferred. Irving Fisher in *The Making of Index Numbers* advocated the geometric means of the indices of price and of quantities respectively as the ideals. Dr. Rhodes in the memorandum referred to by Mr. Leak and used in the book had definitely the purpose of testing the relationship of the methods to each other and of considering their validity. It was therefore necessary to obtain the relevant data from the volumes of the Censuses of Production and to use whatever hypothesis was most suitable.

The problem can only be understood by the help of suitable notation. Write  $p_0, p_1$  for prices,  $q_0, q_1$  for quantities of gross output of one commodity at the initial and final year. For net outputs write  $p_0', q_0'$ , etc.

The indices of production are then  $J_1 = S(p_0 q_1)/S(p_0 q_0)$ ,  $J_2 = S(p_1 q_1)/S(p_1 q_0)$  for gross output, and  $J_1' = S(p_0' q_1')/S(p_0' q_0')$ ,  $J_2' = S(p_1' q_1')/S(p_1' q_0')$  for net output.

Of these eight  $pq$  sum-products only four are given directly in the Censuses, viz.,  $v_0 = S(p_0 q_0)$ ,  $v_1 = S(p_1 q_1)$ ,  $v_0' = S(p_0' q_0')$ ,  $v_1' = S(p_1' q_1')$ . But  $p_1 q_0$  is also computed for each of 130 industries approximately, using for each industry those products which can be measured quantitatively (1930 Census, V, pp. 142–6).

The Board of Trade's serial Index of Production is of the form  $Sv_0' q_1/q_0 \div Sv_0'$ . This illustrates the difficulty of measuring the change in net output on the basis of quantities that are necessarily of final or gross output of particular industries. To reduce it to the form  $J_1'$  it must be assumed that, for the total or any sub-total given,  $q_1/q_0$  is a sufficient approximation for  $q_1'/q_0'$ . That the similar process described below was followed in the book (p. 138) appears to be the gravamen of Mr. Leak's criticism (p. 60).

The method summarized in the Census 1930, V, p. 43, appears to be a curious hybrid. It is of the form  $S\{v_0' \cdot S(p_1 q_1)/S(p_1 q_0)\} \div Sv_0'$ , where the inner summations extend in each industry over the goods quantitatively measurable. Apart from the inescapable difficulty that net output weights must be applied to gross output data, the form  $J_2$  is used where  $J_1$  is algebraically required. It would be more natural to use the form adopted by Dr. Rhodes, viz.  $S\{v_0' S(p_0 q_1)/S(p_0 q_0)\} \div Sv_0'$ , where all prices are taken in the same year. For the period 1930–35 Dr. Rhodes' figures are used in the book. For the earlier period the corresponding calculation had not been made, and the difficulty of the data and the amount of work required were deterrent. Consequently it was assumed,



as was implicitly done in the Census computation, that for each of the 130 industries  $J_2 = S(p_1q_1)/S(p_1q_0)$  might be taken instead of  $J_1 = S(p_0q_1)/S(p_0q_0)$ , with the expectation that the inexactness would be reduced when the industries were aggregated into 14 main groups (and no more minute detail was published) and be unimportant in the general index-number which was the main objective. This is precisely what was done in the Census,\* and yields the results I have called  $J_1'$ . The last column in the lower table on p. 138 in the book, headed "1924 at 1930 values" (and used for  $J_2$  and  $J_2'$  in the main Table), is of the form  $p_1'q_1' \div S(p_1q_0)/S(p_1q_1)$ , all the figures being taken from the Census, and Mr. Leak's criticism is wrongly directed; it should have applied to the  $J_1$  computation, and that is precisely the computation made in the Census Report. But obscurity in the text is admitted, and it is well to go into more detail. There are two questions. The first is whether the quantity index based on the final product can be applied to the rather elusive conception "the net output" for an index-number for one industry. Mr. Leak agrees with one relevant sentence in the book; he writes, "If, as is continually happening, the same quantity of materials is being used to produce a greater volume of goods," while on p. 138 in the book there is the phrase "if throughout industry on the average there is a tendency to use the materials for finer purposes"; but his application is to price index numbers, while that in the book is to the correlative quantity index.† The second question is whether much accuracy is lost by using  $J_2$  instead of  $J_1$  for individual industries. Dr. Rhodes devoted much space to their relationship, and found *inter alia* that in the period 1924-30 in 24 cases he examined  $J_2$  was less than  $J_1$  and in 22 was greater. We should expect  $J_1$  to be greater than  $J_2$  if relative increase in price was positively correlated with relative decrease in production. The application to cutlery, which Mr. Leak instances, is taken by Dr. Rhodes as the most marked illustration of the inherent difficulty of measuring production when the nature of the output changes, or at least of the great possible discrepancy between the equally valid  $J_1$  and  $J_2$  measurements. To test whether the use of  $J_2$  instead of  $J_1$  (admittedly not appropriate for use in extreme cases taken separately) is valid for wider computations in which minor inexactitudes may cancel, I have applied the method used for 1924-30 to the data for 1930-35, using only rather summary methods. I find that  $J_1$  thus reworked for the whole of industry is 120, while the more complete method used by Dr. Rhodes of calculating  $J_1$  for each industry gives 123. Meanwhile  $J_2$  for all industry is 114. In this period  $J_1$  was greater than  $J_2$  in 31 cases, less in 15 of the industries examined by Dr. Rhodes and consequently for the aggregate the difference between  $J_1$  and  $J_2$  is greater than in the earlier period. The test suggests that the short cut method was sufficiently close in the earlier period for an estimate which in no case can be made very precise, but is not "definitely faulty," as Mr. Leak describes it.

It is perhaps not necessary to meet all Mr. Leak's criticisms in subsequent

\* The difference in the Clothing Trades index, instanced by Mr. Leak, is inexplicable. Using precisely the same data (as I suppose) from 1930 Census I and V, I obtain 109.47, while the Census gives 111.5. On his first point, it is, I think, clear from the last two paragraphs of p. 137 that it was realized that the Census summary for 14 groups depended on detailed work for each of 130 industries. That the whole method followed in the book is more complicated than in the Census, and differs in some cases from it, is clear from what is here written.

† The same consideration applies in a different form to the Board of Trade serial index number of production. How can the change in the output of motor vehicles, for example, be measured?

paragraphs at length. The tabulation according to firms assigned to each industry, rather than that by products whether of these or other firms, was in accordance with the Census V, pp. 142 *seq.* Even if all the 1930-35 final figures had been available, it would have been doubtful whether a changed tabulation should have been used for the second Table.

The difference between Dr. Rhodes' and Mr. Devons' method is fully analysed in the book, pp. 144-5. In theory there is little to prefer one to the other; each rests on arbitrary assumptions, which are broadly justified for the computation of an aggregate index, though not for all of the industries separately. The broad results of the two methods agree, and that of Dr. Rhodes was preferred (if for no other reason) because he gave the details required for the analysis.

It was thought to be of considerable interest to break up the change in price of finished articles into the part due to change in the price of the materials or partly manufactured goods used and the cost per unit of manufacture. The work was of an experimental nature and, since the results were not used in the sequel, no detailed analysis was made. The broad results were at least suggestive of important changes, and, since prices of materials fell rapidly from 1924 to 1935, the influence of these prices on the final selling price certainly called for analysis. It was natural to make a rough comparison of the results with other measurements of the changes of prices of materials, etc.; but the coverage of the Census of Production figures and those of the index-numbers of the Board of Trade and the *Statist* are not the same, and it was not worth while to make a detailed analysis. Mr. Leak writes that "the author expresses satisfaction that there is a very close agreement . . ." in fact the author only wrote in a colourless way that "the agreement is very close." He might have written equally well "is unexpectedly close."

Mr. Leak writes, categorically, that "the addition of the volume index-numbers by any method other than by net output is not justified" and that "all the deficiencies in the figures are accumulated in these index-numbers (of prices)." I could find some quite cogent uses for the aggregates thus obtained, but the argument, introducing for example the theory of money, would not be suitable here. It is more to the immediate point to say that the numbers resulted from an algebraic process clearly defined, applicable with more or less precision to particular industries and groups, and that they have their place, like other averages, in marking a central position with which the separate entries can be compared. How far they would be affected by more refined methods is related to the question how far duplication of weights affects the resulting index-numbers.

**SMALL FIRMS.**—The information about small firms is scattered through the Census Reports, and the nature of the information and its treatment vary considerably from date to date. A great amount of detailed study, described very briefly on pp. 174-9, was devoted to their examination, and only summary results were published. There is a large element of approximation both as to the numbers of persons employed by firms who made no returns to the Census and as to the Net Output of small firms. The Census estimates in many cases differ in successive volumes for figures applying to the same year. It is therefore not surprising that in some cases the estimates on pp. 176-7 do not tally exactly with the most recent Census Reports, some of which were not available at the time the analysis was made.

Mr. Leak instances five cases where there are discrepancies.

*Tailoring.*—For 1924 the number of employees is estimated as 115,000–120,000 in the Census, 1930, Part I, p. 385. Mr. Leak in his note gives 112,000. The estimate in *Incomes*, p. 176, is 123,000, based on:

No. of firms making returns .	17,900.	Number employed .	63,000.
No. not making returns, including an estimate for Ireland .	15,700.	Number employed .	60,000.

where the last entry is necessarily rather conjectural.

*Building.*—Mr. Leak says that the number given on p. 176 as employed in 1930, viz., 167,000, differs by 4,000 from the official estimate. But Census, 1930, IV, p. 179 states 166,000, and 1935, V, 168,000; so presumably the figure has been revised officially. In any case there is great uncertainty in any estimate of the number employed by 3,950 firms who made no return.

*Motors and Cycles.*—In the preparation of the estimate for 1930 there was some hesitation as to whether £10 millions or £7 millions should be taken for 1930. The published detail is obscure, and estimates had to be made of the value of the work done by very numerous repair shops. Between 1924 and 1930 there was a development in the supply of ready-made parts by the manufacturers and the work became less skilled, so that the value of the output per head diminished; by how much is a matter of conjecture.

*Chains, Screws, etc.*—Here the figures for net output are so small that a trifling modification of the estimate would turn £2 million  $\pm$  .5 (1924) and £3 million  $\pm$  .5 (1930), p. 177, to a reversal of order as in the official estimate. It is not now possible quickly to recover the details and the entry is of trifling importance.

*Mines and Quarries.*—In 1930 quarries worked by Local Authorities are excluded. In the book, and in 1924 and 1930 persons connected with collieries idle or in course of development are included. In both cases the Census took the opposite decision. The differences, which are thus completely explained, are numerically unimportant, either in relation to the whole number employed in mines and quarries or to the total employed by all small firms in industry.

It would have been a satisfaction to the writers if it had been practicable to take up the details with the Board of Trade. But the differences instanced by Mr. Leak are on the whole slight, so that (even if they had been known at the time of writing) the expenditure of official time during the preoccupations and disturbances of the war would not have been justified. For the purpose of the book the important thing was to complete the estimates on pp. 124–5 for all firms, and for that very precise valuations were not necessary. It should be clear to any student using the detailed figures, whether they emanated from the Board of Trade summaries or from the analysis described in the book, that they cannot be used for any refined calculations but only for showing roughly the order of their magnitude.

## REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—*Poisson's Exponential Binomial Limit*. By E. C. Molina. New York : Van Nostrand Company, Inc. 1942. 11" × 8". 45 + 47 pp. \$2.75.

This volume comprises two tables, the first of the Poisson limit  $a^x e^{-a} / x!$ , and the second of the cumulated sum  $\sum_{x=c}^{\infty} a^x e^{-a} / x!$ . The tables are to seven decimal places for argument  $a = 0.001 (0.001) 0.010 (0.010) 0.40 (0.10) 15 (1) 100$  and  $x$  for whatever values (0-150 when  $a = 100$ ) give significant figures in the first seven places. They are reproduced from typescript, but are fairly readable and conveniently laid out.

The range of the tables is considerably greater than that of previously published work, and they should be very useful in investigations concerning the happening of comparatively rare events. M. G. K.

2.—*Birth, Poverty and Wealth. A Study of Infant Mortality*. By Richard M. Titmuss. Hamish Hamilton Medical Books. London, 1943. 7¼" × 4¾". 118 pp. 7s. 6d.

In this book Mr. Titmuss demonstrates that it is possible to arrive at important conclusions regarding infant mortality by using the most elementary statistical methods only. He is concerned with problems of differential mortality and with the movement of what he calls the "social gradient" between 1911 and 1930-32. He contends that class differences in infant mortality have increased during that period.

It is well known that during the last three decades Great Britain has seen a steady fall in the infant death rate. There is no reason for complacency, however, as the English rate still compares unfavourably with those of some of the Dominions and of continental countries. But Mr. Titmuss's interest in the actual size of the decline is secondary; he is mainly interested in the different rates of decline in different social classes. Using the Registrar-General's classification, the following figures may easily be calculated from the table on p. 26.

Per Cent Decline of Infant Mortality between 1911 and 1930-32.

Class . . .	I	II	III	IV	V	All Classes
Decline . . .	56.6	57.6	48.7	45.1	49.7	50.4

As in 1911, the infant death rate was lowest in Classes I and II and highest in Classes IV and V, the lowest death rates have seen the greatest proportionate decline. It is therefore evident that the inequality between different classes has increased.

In order to present this phenomenon, Mr. Titmuss, however, uses a method which is open to objection. He calculates the infant death rates of each social class as a percentage of the corresponding rate for all social classes, and as the resulting ratio is higher in 1930-32 than in 1911, he contends that this shows an increase in inequality. Now, the infant death rate for all classes is a weighted

average, whose size is affected not merely by the infant death rates for the separate social classes, but also by the number of births in each social class. It is possible that the infant death rate may change for all classes, even though the separate social class death rates remain constant. This may lead to erroneous conclusions, though it is only fair to say that in this particular case any error is likely to work in Mr. Titmuss's favour. The proportion of births taking place in Classes IV and V is likely to be higher in 1930-32 than in 1911, and their high death rates will raise the rate for all classes. If there is still an increase in the ratio of Class V rates to the average rate, the author's conclusions are strengthened.

Mr. Titmuss proceeds to break up the yearly rates into rates for different periods during the first year of life. He shows that there is not a very great deal of class differential in neo-natal death rates and in deaths from congenital causes, so that most of the differential in the total rate may be ascribed to environmental differences.

It is a sad commentary on the state of our vital statistics that the last period for which information is available on this important problem is the year 1931. There is, however, no *a priori* reason for believing that the situation has changed appreciably during the 'thirties. Progress has been made in the Maternity and Child Welfare Services, but emphasis has been laid on the medical rather than on the environmental side. If Mr. Titmuss is right, the social side of the maternity services should be developed energetically, although the effort of the medical side must not be relaxed, if a further fall in the infant death rate is desired. Those who are anxious about the future of the population of this country have not always paid as much attention to the reduction of infant mortality as they have to methods of increasing fertility. The book is valuable in showing how much scope there remains for reducing infant mortality, although, of course, no possible reduction is sufficient to raise the reproductivity of the population to replacement level.

It is rare to be able to recommend a book on vital statistics to the expert and layman alike. The simplicity of the methods used and the importance of the results obtained, however, justify such a recommendation in this case.

E. G.

3.—*Young Offenders: An Enquiry into Juvenile Delinquency*. By A. M. Carr-Saunders, Hermann Mannheim and E. C. Rhodes. Cambridge University Press. 1942. 5½" × 7½". 165 pp. 7s. 6d.

This Report is the result of an investigation undertaken in 1938 at the instigation of the Home Office. In the first place, attention was directed to the question of juvenile delinquency in London, and in the light of this preliminary experience the enquiry was extended to six large provincial towns. The two opening chapters dealing with the history of the subject and trends in the incidence of juvenile delinquency are attributed to Dr. Mannheim, while the record of the actual investigation is by Dr. Rhodes. The conclusions, given in the final chapter, are presumably the work of the three authors co-operatively.

It is not perhaps generally realized that as long ago as 1816 a private Committee including James Mill and David Ricardo investigated the "... alarming increase of juvenile delinquency in the Metropolis," and concluded that among the main causes responsible were the improper conduct of parents, the want of education and of suitable employment, the violation of the Sabbath and the habits of gambling in the public streets. These findings were confirmed by the several official Committees which were appointed throughout the nineteenth century. These Committees, however, also mentioned the severity of the penal code and the inefficiency of the Police Force, while there was at least one reference to "the extremely low price of spiritual liquor." The bibliography dealing with juvenile crime from the beginning of the nineteenth century to date is discussed in a way that admirably combines the merits of brevity and clarity. The trends in the incidence of juvenile delinquency since the beginning of the present century constitute the second chapter. Particular care has to be exercised in

handling these figures, for the reason that a series of statistics in this connection is necessary over fairly long periods, while at the same time, by reason of change in the criminal code and its administration, strictly comparable figures over a series of years are almost impossible to secure. Dr. Mannheim, fully aware of this difficulty, is cautious in his approach and in his conclusions. After considering the number of delinquents by sex, age and the type of offence committed, as well as in relation to the population, it is concluded that the extent and trend of juvenile delinquency are such as to justify the present investigation.

To provide the basic data for Dr. Rhodes's investigation, an endeavour was made to collect the first 1,000 cases brought before the juvenile courts in London after September 1938, and with each such case coming forward, a school classmate with an innocuous record was to be selected in order to provide a corresponding number of controls. In the result 989 delinquents and 1,000 controls were provided from London and, including fewer cases in the six provincial towns, all told there were secured 1,953 delinquents and 1,970 controls. These cases were first analysed according to the constitution of the family, with the result that the view that "broken" family life predisposes children towards delinquency was confirmed. From further analysis it is concluded that the chance of a delinquent coming from a home with an abnormal character was three or four times as great as the chance of a delinquent coming from a normal home. Generally the delinquents were somewhat "inferior" in type and interests to the controls, who had better school records and were generally more lively. The fact that 30 per cent. of all juvenile offences in London before the war were committed in the hours of darkness implies a laxity of parental control, an improvement in which would probably be reflected in a reduced incidence of delinquency. The school record was, not unexpectedly, very much better for the controls than for the delinquents, and a similar conclusion was reached with regard to church attendance. Leisure interests were also analysed, together with a series of other factors, such as illegitimacy, other delinquents in the family, previous offences, unemployment and pocket money. The nature of the offence, the time when it was committed in relation to a schedule of "curfew hours," and finally the age of the boy in relation to the class of offence and type of family complete the factual investigation.

In the final chapter, which summarizes the conclusions, it is suggested that the results of the investigation may well seem disappointing to those who look for the specific, new and adverse influences which have been responsible for the increase in the "real" incidence of juvenile delinquency. The results of the enquiry are very largely concerned with the general characteristics of the actual cases under investigation, and do little to illuminate the characteristics which bear on the subject over a period of time. It is accordingly emphasized that special and occasional statistical investigations cannot bring out aspects of long-term influences, and moreover that "the detection of atmospheric changes" is hardly so much a matter for statistical enquiry as for the general evaluation of social habits and customs.

But the authors need not unduly express their fear of giving rise to disappointment. Those interested in the subject will find much to satisfy them in this enquiry, while those who are less concerned will find their interest stimulated. The action to be taken in order to put to maximum advantage the facts so clearly demonstrated in this careful study is, of course, another issue entirely, and the authors would certainly be justified in their fear of disappointment if this investigation merely remains a study of facts, however interesting the facts may be.

R. F. G.

4.—*The Rice Economy of Monsoon Asia*. By V. D. Wickizer and M. K. Bennett. Food Research Institute, Stanford University, California, 1941. 8½" × 5¾". xiii + 358 pp. \$3.50.

After carefully expunging from my mind the extraneous merits which this book derives solely from the topical nature of its contents, I can find no adverse criticism of serious import to make, and can do no less than recommend this

volume to the attention of all persons who are seriously interested in the post-war economic problems of the world, as distinct from those of Europe only.

Am I incorrect in thinking that most of us have tended to concentrate upon the rehabilitation problems with particular or exclusive reference to Europe? If this is the case—and in the main I believe that my impressions are correct—then this publication supplies a very valuable corrective. The authors, without erring on the side of over-emphasis, leave the reader in no doubt as to the fundamental importance of *rice* as one of the major staples of world economy; in doing so, they succeed admirably in their purpose of providing both a contribution "to a better understanding of Far Eastern food problems" and a stimulation "to the growth of fuller knowledge through the work of others in the years ahead."

The list of chapter headings indicates the completeness of the investigation, and the text makes it quite clear that we have in this book a well-balanced combination of field and library research. Naturally, a flat uniformity of excellence is something which one cannot hope to meet; I found that the chapters dealing with "Consumption Trends since 1920," "Trends in the Asiatic Rice Economy" and "Rice in Asiatic Diets" particularly interesting.

This publication is a worthy successor to its forerunners: *Agricultural Russia and the Wheat Problem* (1932), and *Competition among Grains* (1940), both of which appear to have received less attention than they merited. The work is well produced, and the tables, charts and cartographs which it contains serve their purpose fully: in no case do they obscure rather than illuminate the data they represent. The textual matter is very readable, and is amply supported by the well-constructed tables to be found in the Appendix.

Let me once again urge the desirability of this volume being read and studied. The settlement of the economic problems of the Far East will not be a simple matter, and here is the opportunity to secure a really comprehensive understanding of the basic factor in those problems. I do not think that the really serious nature of the difficulties involved in rice economy has been—or could be—overstressed: this is equally true of the importance of rice, directly or indirectly, to all "who on this earth do dwell," whether occidental or oriental.

To quote the authors, "Whatever the future may hold, it is difficult to visualize any type of world order in which the problems of the Far East will cease to be of growing significance to the Western world. . . . Rice not only reflects the social and economic pattern of life for the agricultural masses of Monsoon Asia, but it is also the symbol of their hopes. Rice is the peasant farmer's means of subsistence, his first need and principal possession, his medium of exchange and standard of value. . . . Eventually, if imperfectly, the expression of man's hopes is translated into the political sphere. When rice is scarce or dear and families must go hungry, man will work harder and longer, but when his position seems to be without hope, he will also fight and kill to survive." This is a warning that must not be disregarded. F. E. R.

5.—*Standardized Accounting in Germany*. By H. W. Singer. (Occasional Paper No. V of the National Institute of Economics and Social Research.) Cambridge University Press. 8½" × 5½". 68 pp. 6s.

Dr. Singer's approval of standardized or uniform accounting as a basis for business economics is indicated on page 10: "In this country, with its tradition of individual liberty . . . it is probable that means could more easily be found of achieving the objects of standardized accounting in a different way: with the stress on voluntary agreements by individual trades; by holding out economic inducements to the adoption of approved schemes and the maintenance of satisfactory records, and by using the accounting profession and its influence on business and finance to induce a movement towards agreed uniform systems."

The Germans preferred fines to economic inducements, and they certainly secured rapidly the adoption of uniformity and the approval of several writers quoted by Dr. Singer.

Page 50 summarizes the advantages as being an aid for State planning,

public contracting, State intervention (concentration, control of investment, levies and subsidies) and internal business efficiency. Page 38 states that the departmental summaries afford little guidance for price-fixing, but here it seems necessary to qualify an appreciative review of a useful book by the following criticisms of apparent inconsistencies.

On page 20 it is indicated that the departmental analysis of costs (including unpaid interest, etc.) is summarized each month and the totals debited to Accounts in Group 5, but in the Plan of Accounts this group is headed Reconciliation Accounts. A related confusion is that the Accounts actually listed in this group on the plan do *not* correspond with any line or column of the Monthly Cost Summary, on which it is said to be based. On the contrary, they indicate an analysis of the *output* of each department by major cost class (Material, Labour, Oncost), and it may be that the heading Reconciliation refers to the difference between Cost and Output. The main problem of how to separate the variation due to efficiency factors from that due to prices and rates is not made sufficiently clear.

The next group, No. 6, is stated on page 20 to be an analysis by Product Group, but this does not agree with the Plan, which merely suggests a more detailed departmental analysis by Cost Centres. The text has little to say about this group, and fails to make clear the difference, if any, between this product analysis and job-costing, which comes in for severe criticism as being useless (Government Supply Departments please note).

Related to the sectional analysis within departments, the Monthly Cost Summary records Machine Hours worked, but it seems to the reviewer very arbitrary to aggregate hours of diverse machines; it would be more informative to report the *cost* of idle machine hours, evaluated at standard hourly rates for each machine and then added.

Again, the important section on pages 36-38, on the extension of Departmental Accounting to Cost Centres, and even to individual employees, fails to make clear how the comparison between cost and output is obtained, and there is no reference to possible use of this comparison as a basis for weekly incentive wage systems. A less important omission is the failure to make clear whether wastage of materials is attributed to the various departments, cost centres or employees.

On page 31 Dr. Singer seems to draw an unnecessary distinction between German Soll-Kosten and British Standard Costs. It may be that the British practice concentrates unduly on the standard, and adjusts it too often to changing conditions, but the difference is only one of degree. The Germans realize fully that the function of standards is merely to act as weights for aggregating the important variations in efficiency, prices and time-rates. There is no indication in the book that the Germans have solved the problem of interaction between changing quantities and changing prices or rates.

Another apparent inconsistency is the grouping of reserves for accrued charges in Group 2 on page 20 and Group 0 in the Plan. Page 35 refers to the loss of fixed oncost due to production below "full capacity," but neither the text nor the plan indicates whether the debit is posted to a Group 2 Account, nor whether the capacity level is fixed so high that such postings cannot be credits, representing savings in fixed oncost to compensate for excessive machine-rates.

As might be expected, the Germans have managed to make a simple subject complicated and ponderous by the use of new train-like-words, omitting hyphens. Dr. Singer translates *Uebergangskonten* (p. 57) as "transit accounts," but the context indicates a better translation as change, variation or possibly "Overflow." In the glossary *Abrechnung* might be better translated as Summary, since most of the figures are merely tabulated from other sources.

Dr. Singer has performed a great service in making known to us the basis of German business economics. Just as we learned during 1914-18 the secret of the German training of chemists, so let us not fail to learn now how to train accountants in business economics. As an individualistic nation we may have lost our initial lead in accounting, but with goodwill and a little trouble



we shall be able to improve on cumbrous German attempts at uniformity of records.

A final quotation from page 37 will indicate the importance of Dr. Singer's service to accountants, managers and the British public.

" Departmental accounting systems are also used to facilitate the decentralised administration of large-scale enterprises. The managers of departments and even the foremen in charge of benches or stages of manufacture are accorded a measure of responsibility, thus approximating their function to that of small-scale entrepreneurs under a regime of free competition."

D. S. B.

## STATISTICAL NOTES

## 1. BRITISH OFFICIAL STATISTICS

DURING the three months April to June 1943 the general trend of *wholesale prices* continued slightly upward, the Board of Trade index number advancing from 162.2 to 163.1, or rather more than  $\frac{1}{2}$  per cent. (averages for 1930 = 100). Food and tobacco prices rose 0.8 per cent. and prices of industrial materials and manufactures 0.4 per cent. It has to be borne in mind, however, that, owing to the prices of many articles being controlled, and consequently to a large extent practically stationary, any movement of general prices must be of a minor character. There was an increase in the price of tobacco of between 19 and 22 per cent., but this was due to increased duties taking effect from April 13, and a continued rise over several months in jute prices. The price of varnish also rose considerably, and there were smaller advances in the prices of milk and goat-skins. On the other hand, there was in June a decline in the effective prices paid by controlled millers for homegrown and imported wheat, and a fall in the price of English barley.

The following table sets out the Board of Trade index number \* of wholesale prices for the four months March 1943 to June 1943 with comparative figures for some earlier months.

(Averages for 1930 = 100)

Date	Total Food	Total not Food	All Articles	Basic Materials (excluding Fuel)	Intermediate Products	Manufactured Articles	Building Materials
March 1943 ...	160.0	163.0	162.2	172.2	170.9	153.9	148.0
April    " ...	161.2	163.3	162.8	172.6	170.9	154.3	149.5
May     " ...	162.2	163.4	163.3	173.5	170.7	154.3	150.0
June    " ...	161.3	163.7	163.1	173.9	171.4	154.3	150.0
June 1942 ...	160.4	158.9	159.6	167.9	168.3	151.5	143.6
1941    " ...	145.1	156.1	152.4	167.0	165.6	148.5	139.3
Aug. 1939 ...	90.1	102.2	98.1	91.5	101.0	108.7	101.1
Percentage increase in June 1943 over—							
June 1942 ...	0.6	3.0	2.2	3.5	1.8	1.9	4.5
1941    " ...	11.2	4.9	7.0	4.1	3.5	3.9	7.7
Aug. 1939 ...	78.5	60.1	66.2	84.0	64.6	41.9	44.2

Since the commencement of the war there has been an advance in general wholesale prices of rather more than 66 per cent. Food and tobacco prices have advanced 78.5 per cent. and industrial materials and manufactures 60.1 per cent. The greatest advance of any group has been that of cereals, the prices of which have risen 120.3 per cent., but those of basic materials have risen 84 per cent. and those of textiles other than cotton and wool 82.3 per cent. On the other hand, prices of non-ferrous metals (all controlled) have advanced only 25 per cent.

\* The Board of Trade states that "In cases where the Government buys a commodity at one price and resells it at a lower one (e.g., home-produced meat), the subsidised price is the one used for the index; where different prices are charged according to the use to which the article is put (e.g., in the case of sugar and flour) a weighted average of these is taken.

The figures for certain other British index-numbers of wholesale prices are given below, together with those of the United States Bureau of Labour.

Date	Board of Trade (1930 = 100)	Economist (1927 = 100)	Statist (1866-77 = 100)	The Times (1913 = 100)	U.S. Bureau of Labour (1926 = 100)
March 1943 ...	162.2	114.2	154.0	178.6	103.1
April „ ...	162.8	114.6	154.9	178.4	103.5
May „ ...	163.3	114.8	155.6	178.6	103.8
June „ ...	163.1	114.8	155.4	178.3	103.6
June 1942 ...	159.6	110.7	154.4	181.6	98.4
„ 1941 ...	153.4	104.8	144.4	170.2	86.9
Aug. 1939 ...	98.1	70.3	90.4	114.5	74.8
Percentage increase in June 1943 over—					
June 1942 ...	2.2	3.7	0.6	1.8 *	5.3
„ 1941 ...	7.0	9.5	7.6	4.8	19.2
Aug. 1939 ...	66.2	63.3	71.9	55.7	38.5

Decrease.

During the months of April, May and June 1943 there was very little general change in the *cost of living* as measured by the index-number prepared by the Ministry of Labour and National Service, covering the principal items of expenditure of working-class families. There were further reductions in the cost of clothing, due to the increasing proportion of utility cloth and apparel on sale at prices appreciably below those of non-utility goods of corresponding quality. On the other hand, there was an advance in June in the price of potatoes, due to the replacement of the old crop by the new. Since the commencement of the War the complete index number had at July 1st, 1943, advanced about 29 per cent., that for food about 22 per cent., for clothing 67 per cent., for fuel and light 34 per cent., and for other articles 60 per cent. (hardware, soap, pottery, tobacco, etc.).

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items	All Items
April 1st, 1943 ...	165	164	355	244	268	198
May 1st, „ ...	165	164	350-355	244	286	199
June 1st, „ ...	165	164	350	244	286	198
July 1st, „ ...	168	164	345-350	244	286	200
July 1st, 1942 ...	160	161	405	232	261	200
„ 1st, 1941 ...	167	164	375	228	227	199
Sept. 1st, 1939 ...	138	162	205-210	180-185	180	155
Percentage increase at July 1st, 1943, over—						
July 1st, 1942 ...	5	—	14 *	5	8	—
„ 1st, 1941 ...	0.6	—	7 *	7	26	—
Sept. 1st, 1939 ...	22	1	67	34	60	29

Decrease.

Of the increase of 29 per cent., or 45 points, in the index-number, since the beginning of the War, about 4½ points, or nearly 3 per cent., represent the effect of the increases in the taxes on sugar, tobacco and matches, and approximately 1½ points, or nearly 1 per cent., are due to increases resulting from the Purchase Tax.

In continuation of its half-yearly statistics \* of the average weekly earnings of workpeople in manufacturing and other industries, the Ministry of Labour and National Service has published in the June issue of the *Labour Gazette* similar statistics of the earnings in the last pay-week of January 1943. Returns were received from about 54,700 establishments covering (including part-time workers) over six and a quarter millions of workpeople. The earnings of office staffs, shop assistants and outworkers working at home on materials supplied by employers were excluded from the returns, as also were those of managers, clerks, commercial travellers and typists, but those of foremen, transport workers, warehousemen, etc., were included. The earnings given were inclusive of bonuses, and were the total earnings before deductions for income tax and workers' contributions to statutory insurance schemes (health, unemployment, pensions, etc.). Earnings of women part-time workers not working for more than 30 hours per week are included in the statistics, two part-time workers being taken as representing one full-time worker. Particulars are given of earnings of 16 industrial groups and 90 separate industries. Returns were not obtained from coal mines and railways.

Industry Group	Average weekly earnings in—		Percentage increase over Oct. 1938 of average weekly earnings in—				
	Oct. 1938	Jan. 1943	July 1940	July 1941	Jan. 1942	July 1942	Jan. 1943
	s. d.	s. d.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Iron, stone, etc., mining and quarrying ...	56 8	84 3	22.1	38.8	32.6	48.8	48.7
Treatment of non-metallic mineral products ...	61 0	93 1	26.1	38.2	33.3	49.3	52.6
Brick, pottery, glass ...	47 8	74 5	19.8	35.8	35.8	50.3	56.1
Chemical, paint, oil, etc. ...	55 0	85 8	25.3	35.7	35.6	47.3	55.8
Metal, engineering and shipbuilding ...	59 8	103 0	42.3	49.2	55.9	66.8	72.6
Textiles ...	37 10	61 5	29.5	37.7	43.0	56.6	62.3
Leather, fur, etc. ...	46 9	71 9	16.8	31.4	37.6	46.7	53.5
Clothing ...	35 0	52 6	12.9	27.9	29.5	46.2	50.0
Food, drink, tobacco ...	47 0	68 11	15.4	29.4	29.6	40.8	46.6
Woodworking ...	51 10	74 5	16.7	31.4	27.8	42.9	43.6
Paper, printing, stationery, etc. ...	57 7	76 2	1.6	17.9	20.5	27.9	32.3
Building, contracting, etc. ...	61 2	87 10	32.6	47.6	27.7	54.6	43.6
Other manufacturing industries ...	46 6	78 6	31.0	40.6	47.3	60.2	68.8
Transport, storage, etc. ...	65 6	90 7	20.6	25.6	28.8	37.4	38.3
Public utility services ...	59 8	76 10	10.6	20.2	22.9	27.9	28.8
Government industrial establishments ...	70 6	97 7	33.9	26.8	27.3	34.8	38.4
All the above ...	53 3	87 11	29.9	42.4	46.0	59.9	65.1

\* For some of the results see Part IV of the *Journal* for 1941, pp. 390-2, and Part IV of 1942, pp. 358-60.

The following table gives the average earnings of all workers in the 16 industrial groups in January 1943 and October 1938 and the percentage increases at the five census dates over the earnings at October 1938, the latest pre-war date for which similar particulars are available.

Although the numbers of workpeople covered were sufficient to afford a satisfactory basis for the average earnings in each industry, the average for all industries combined was affected by the varying proportions of workpeople covered in the returns so far as each industry was concerned. The general averages for all industries combined and for each of the 16 groups have therefore been recalculated in the above table on the basis of the estimated total numbers of wage earners employed in the individual industries at the dates of each census. The averages cover all classes of manual wage-earners, including unskilled workers and general labourers, and are inclusive of payments for overtime, night work, etc., and of amounts earned on piece work and other methods of payment by results. In view of the wide variations as between different industries in the opportunities for extra earnings, and in the differing proportions of male and female workers and adult labour employed, the averages shown are not to be taken as any evidence of the disparity in the rates of wages prevailing in the different industries for comparable classes of workpeople employed under similar conditions.

The earnings of men, youths and boys, women, and girls separately are shown in the table below for industry generally. In the *Labour Gazette* they are given separately for each of the 16 industrial groups and for each of the 90 industries.

Date	Men (21 years and over)	Youths and boys	Women (18 years and over)	Girls	All workers
Average weekly earnings					
	<i>s.</i> <i>d.</i>	<i>s.</i> <i>d.</i>	<i>s.</i> <i>d.</i>	<i>s.</i> <i>d.</i>	<i>s.</i> <i>d.</i>
Oct. 1938 ... ..	69 0	26 1	32 6	18 6	53 3
July 1940 ... ..	89 0	35 1	38 11	22 4	69 2
" 1941 ... ..	99 5	41 11	43 11	25 0	75 10
Jan. 1942 ... ..	102 0	42 6	47 6	26 10	77 9
July 1942 ... ..	111 5	46 2	54 2	30 3	85 2
Jan. 1943 ... ..	113 9	45 1	58 6	32 1	87 11
Percentage increase compared with October 1938					
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
July 1940 ... ..	29.0	34.5	19.7	20.7	29.9
" 1941 ... ..	44.1	60.7	35.1	35.1	42.4
Jan. 1942 ... ..	47.8	62.9	46.2	45.0	46.0
July 1942 ... ..	61.5	77.0	66.7	63.5	59.9
Jan. 1943 ... ..	64.9	72.8	80.0	73.4	65.1

Over the period October 1938 to January 1943 the increase in average earnings has been 65.1 per cent., a figure considerably in excess of the increase in the average level of rates of wages for a full ordinary week's work exclusive of overtime. This latter has only been between 26 and 27 per cent. The difference between the 27 and the 65 per cent. is due to fuller employment, longer hours, the working of nightshifts, increased week-end and Sunday labour. The increased numbers of women and boys employed on work

previously done by men have largely contributed to the relatively high percentage increases shown in their average earnings.

The highest average weekly earnings of men (both skilled and unskilled) at January 1943 were in motor vehicle and aircraft manufacture and repair (148s. 7d.), in shipbuilding and repairing (130s. 8d.), and in steel smelting, rolling etc. (130s. 7d.). The earnings of youths and boys were highest in non-ferrous metal manufacture (66s. 0d.), public works contracting (59s. 5d.) and in iron ore and ironstone mining (58s. 11d.). For women the highest average earnings were in motor and aircraft manufacture (74s. 9d.), non-ferrous metal manufacture (69s. 10d.) and in tramway and omnibus service (69s. 5d.), and for girls in motor and aircraft manufacture (43s. 3d.), in Government industrial services (41s. 2d.) and in brass and yellow metal goods manufacture (40s. 1d.).

The increases in the general level of average earnings of all classes has partly been due to the "transference of workers from industries and occupations in which wages were relatively low to those with a higher level of earnings."

In the coal-mining industry information collected by the Ministry of Fuel and Power shows that for all classes of work-people combined, including juveniles, the average earnings per man-shift worked (exclusive of the value of allowances in kind) were 18s. 10½d. in the three months ended March 1943 compared with 11s. 5½d. in the corresponding period of 1939, an increase of approximately 65 per cent.

The average earnings of wage earners employed in railway service in one week in March 1943 are being compiled by the Ministry of War Transport, and will be published in a future issue of the *Labour Gazette* with comparative figures for March 1939.

*Unemployment* continued to decline during the second quarter of 1943, and the number of workpeople on the unemployment registers of the Ministry of Labour and National Service at July 19th, 1943, had fallen to 73,258, a reduction of 6,833 on the total recorded at April 12th. In addition to the number recorded as unemployed, 19,349 men were classified as unsuitable for ordinary industrial employment, and 604 women as unsuitable for full-time employment. Most of the adult unemployed were no doubt merely in the process of changing jobs, and of the juveniles a large proportion were recent school-leavers not yet placed in employment. Such numbers are, of course, quite inadequate to meet the current demands for labour of all descriptions. Counts of the unemployed on the Ministry's registers are now taken only at quarterly intervals. The numbers recorded as unemployed at certain dates are recorded below.

Date	Wholly unemployed	Temporarily Stopped	Persons normally in Casual Employment	Total	Males	Females
Oct. 12th, 1942 ...	96,017	2,196	2,867	101,080	64,872	36,208
Jan. 18th, 1943 ...	93,708	3,114	2,195	99,017	61,709	37,308
April 12th, " ...	76,769	1,312	2,010	80,091	53,838	26,253
July 19th, " ...	71,129	1,118	1,011	73,258	50,236	23,022
July 13th, 1942 ...	101,436	3,264	2,305	107,005	70,024	36,981
July 14th, 1941 ...	219,577	46,027	11,676	277,280	145,529	131,751
" 15th, 1940 ...	636,532	153,242	37,492	827,266	470,197	357,069
Aug. 11th, 1939 ...	968,108	211,978	51,606	1,231,692	947,099	284,593

## 2. OTHER STATISTICS

*Statistics of retail sales.* Returns prepared by the Bank of England in conjunction with various associations of retail traders and Co-operative Societies show that during the six months February to July 1943 the value of the total sales declined 4.0 per cent. The sales of merchandise other than food declined 9.4 per cent., and those of food increased 0.2 per cent. The heaviest decreases were in women's wear (12.8 per cent.), men and boys' wear (24.9 per cent.), boots and shoes (11.8 per cent.), furniture departments (15.1 per cent.) and household piece goods (23.3 per cent.). There was some increased amount of sales in the fancy goods and miscellaneous departments. In view of the marked advance in prices, the reduction of the volume of trade must be very considerable.

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In June 1942, the Office Management Association undertook an enquiry into the salaries of 18,550 clerical employees on the staff of 158 firms and organizations. The data, collected under the auspices of the London School of Economics, have now been published, together with a report on them by Dr. E. C. Rhodes.\* To a large extent, the survey breaks new ground, and thus comparisons with pre-war figures are rarely possible.

For the purpose of this enquiry, posts were divided into six groups, according to the amount of responsibility they carried. The two lowest groups accounted for 21 per cent., and the two highest for 24 per cent. of the replies; in other words, for every supervisor, there were 1.9 persons in the middle grade, who exercise some initiative, but only .9 persons in the lowest grade, who bear little or no responsibility. Actually, women's salaries show a considerable overlap between the lowest and the middle grade, and Dr. Rhodes also comments on the heterogeneity of men's salaries in the middle groups, so that the nature of the classification tends to exaggerate the difference between these two figures.

The staff in each Job Group were further analyzed under three Merit Groups, according to the experience of the employee. Staff in the higher grades were paid proportionately smaller "merit increments" than others, perhaps because there even the lowest Merit Group demands a certain standard of competence.

Analyzing salaries under four groups of industries, we find the lowest median figures in that group which includes the distributive trades. Clerical staff in the manufacturing industries (which account for two-thirds of the replies) were somewhat better paid. Remuneration in commerce, banking and public administration was on a distinctly higher level. The salaries of men employed in public utilities and transport are somewhat higher still, but women in this industry receive only average salaries.

Owing to the call-up, only 36 male clerks were employed to every 100 female clerks. In the public utilities etc., the proportion was still 69 : 100, but in the distributive trades etc., it had dropped to 16 : 100. As regards salary differences between the sexes, these were insignificant in the lowest group (females 22s. 2d. per week, males 1s. 4d. more), but in the highest group men earned over 50 per cent. more than women (females, 94s. 6d., males, 153s. 8d.).

Although only 45 per cent. of the replies came from outside the London

\* Clerical Salaries Analysis, 1942. London : Office Management Association. 48 pp. 10s.

area, it is safe to say that, while for women London salaries are considerably above the average, this is by no means so for men. In manufacture, increments paid for more responsible work seem to be higher in the North of England than elsewhere; this may be due to the depressing effect of pre-war unemployment in the basic industries on junior clerical salaries.

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One of the tasks which the International Labour Office has set itself is to encourage member countries to extend the collection and publication of statistics which reflect working and living conditions in their territories.

Fourteen international conferences and meetings of international committees have, since 1923, discussed these matters, drafted conventions and made recommendation aimed at improving these statistics, and at increasing their international comparability. The present study \* represents a summary of all this work done between the two wars, and it takes stock of the results achieved. The increase in the scope of the statistics published has been considerable. This has largely been due to a general desire for more and better information on social questions, for the I.L.O. by itself will never be able to bring about the collection of figures for which there is not already a latent demand.

In 1925, statistics on five selected topics such as the cost of living, unemployment, etc., were supplied by only fifteen countries on average, while in 1939 figures on these topics were based on data from between 26 and 51 countries, with an average of 33; even by 1942, this figure had only dropped to 32. In that year the I.L.O. collated and published tables on altogether 37 subjects, each one based on data from 24 different countries on average.

A great deal of preliminary spade work had to be done to obtain agreed definitions and classifications in all the various fields under consideration. The resolutions reprinted in the appendix cover employment and unemployment, wages and hours of work, real wages and the cost of living, collective agreements and disputes, industrial accidents, housing and migration. But in no case does the present report indicate to what extent these recommendations have been acted upon: its main purpose appears to be to supply a list of references to all figures, studies and reports previously published by the International Labour Office on any of the above subjects.

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\* The International Standardisation of Labour Statistics. London : P. S. King & Staples (for the I.L.O.), 1943, 4i.



## CURRENT NOTES

FELLOWS who frequented the Society in the old days at Adelphi Terrace will have many recollections of the former Librarian, Mr. J. A. P. Mackenzie, and will have heard of his death with regret. Mr. Mackenzie had served the Society with great loyalty and devotion for over half-a-century—beginning as a young clerk at the age of about sixteen.

For many years before his retirement he had been in charge of the Library and his detailed knowledge of the contents, together with his remarkable memory, made him able to locate information on almost any subject without aid from index references. For some time he combined the functions of Chief Clerk with those of Librarian and was responsible for keeping the Society's accounts; in this capacity his accuracy and industry were very valuable. He had, however, been growing increasingly deaf and retired with a pension at the end of 1939. He died in his 80th year on August 5th, 1943.

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IN May 1943 a telegram addressed to the President of the Society was received from the Statistical Section of the Moscow Scientists' Club. The message ran as follows:—

Sincere New Year to you and to members of Royal Statistical Society. We are confident that coming year will witness defeat of Hitler Germany and that close and prolonged economic co-operation between our two countries after war will help to promote scientific co-operation between statisticians of Great Britain and Soviet Union. On behalf Statistical Section of Moscow Scientists Club,

ACADEMICIAN V. NEMCHINOV, *Chairman*.

PROFESSOR V. STEPANOV, *Vice-chairman*.

The President telegraphed in reply:—

On behalf of Royal Statistical Society wish to thank Section of Moscow Scientists' Club for their greetings and send our own greetings. Cordially agree in the hope that scientific co-operation in the study of social and economic problems may be facilitated by practical co-operation between our two countries and may by mutual study contribute to the value and success of all practical measures.

WILLIAM H. BEVERIDGE,  
*President*.

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On p. 145 of this issue we print the text of a Memorandum on Official Statistics, which embodies the views of the Council on the organisation of statistics in Government Departments.

A Committee of the British Association has also been concerning itself about the matter. Appointed to consider "scientific research on human institutions", they emphasized in their report the need for a training in the handling of social detail which should include statistics, and a section is headed "Need for advice on the preparation of official statistics"—a demand to which the Council's

report may be considered a ready response. The Committee speak very plainly of the various obstacles set up by the methods of presenting official data which block the paths of persons endeavouring to discover and compare the facts. Several shocking examples are exhibited, among them the well known impossibility "of comparing in detail any English census of population with any other, owing to continuous changes in the official categories"; the equally notorious lack of uniformity and standardization in definition of the same items by various authorities, of which the outstanding case is the differences in the classification of industries, occupied persons, and products, in the Census of Production, the Census of Population and the returns of the Ministry of Labour. The Committee also note some official sins of omission; they especially mention the pressing need for a Census of Distribution. The Report was published in *The Advancement of Science*, Vol. II, No. 8 (August, 1943).

A paper in the June issue of the *Journal of the American Statistical Association* draws attention to applications of quality control technique to business administration, that is, to problems of office and financial management. The writer, Mr. W. B. Rice, of the Plomb Tool Company, Los Angeles, carried out various experiments in such applications and considers that the efficacy of the method has been fairly proved. He describes in detail one of the experiments relating to the problem of establishing economical limits for overtime pay to the office staff; which, failing the recognition of such limits, may become an important factor in increasing costs after the negotiation of a contract at fixed prices.

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THE Inter-American Statistical Institute, founded in 1941 with the aim of fostering statistical development in the western hemisphere, is now issuing a quarterly periodical, *Estadística*.

The Executive Committee of the Institute, which is described as a "professional organization," is representative of Brazil, the United States, Argentina, Mexico and Canada, in the persons of Senhor Texeira de Freitas (President), Mr. Stuart A. Rice, Senor C. E. Dieulefait, Senor R. Beteta (Vice-presidents) and Mr. R. H. Coats (Treasurer). The address of the Permanent Office is in Washington, the General Secretary being Dr. Halbert L. Dunn, Chief Statistician of the Bureau of Vital Statistics.

The first number of *Estadística* has, unfortunately, not been received, but the second, dated June, 1943, which recently arrived, enables us to make known this welcome addition to statistical literature. The articles are in English, Spanish, or Portuguese, according to their provenance, with summaries in translation. In the issue before us are several in English. "The completeness of birth registration in the United States," by Dr. Dunn and R. D. Grove, describes the results of a special test made in connection with the 1940 population census and shows to what extent incomplete registration in some States vitiates the figures of the total births recorded. Mr. S. A. Cudmore writes out of his experience on "The special war-time activities of a Central Statistical Bureau"; "Government standards of sampling practice in the United States," by W. E. Deming and M. Gurney, is a brief but informative note on particular applications of sampling lately made by various departments; Dr. W. F. Willcox contributes a historical account of the International Statistical Congress. In Portuguese, the President

of the Institute writes on the Brazilian Institute of Geography and Statistics and the task it has set itself in assisting to develop statistical organization in Brazil as a base for efficient administration. The function of this Institute is to train professional statisticians, experienced in various fields, for employment in statistical work, or as instructors, in federal, provincial, or municipal departments and also in private undertakings, with the object of co-ordinating the economy of the country and generally helping to solve its problems. The papers in Spanish include a comparison of the Statistics of Chile and Peru, by C. P. Jimenez Correa, and the continuation of an article (in the first number) on the Wealth of Mexico, by A. Patiño. Other papers deal with the censuses of Mexico and Panama, respectively; and we note with pleasure a contribution (on the number of centenarians in Brazil) from Professor Giorgio Mortara, whose statistical skill and zeal for exactitude have not been diminished by his exile.

This co-operation of the statisticians of North, South and Central America should greatly help their countries to understand one another's problems and open the way to a wider co-operation. The Inter-American Institute and its organ have our cordial good wishes.

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A cordial invitation to the Officers and Fellows of the Society to use the special reference library of the United States Office of War Information has been received from its Director. In his letter he says, "this is a 'utility' or 'austerity' library but the increasingly valuable collection contains basic printed data explanatory of all phases of American life, and recent data on other subjects published in the United States. Every effort is made to secure the rapid transmittal of at least a single copy of a wide range of American periodicals, books and documents."

The Reading Room is on the ground floor (Room 21) of the American Embassy, 1 Grosvenor Square, and is open every week day including Saturday from 9 a.m. to 6 p.m.

# STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

## UNITED KINGDOM—

### *Agenda—*

*February 1943*—The Beveridge Report: *Barbara Wootton*. Planning—Three Reports: *Professor J. H. Jones*. A comprehensive Health Service: *Professor H. Cohen*. Public Schools and the future: *John Bell*. The reconstruction problem of gold: *E. F. Schumacher*.

*May 1943*—The birthrate and family allowances: *R. A. Fisher*. Maternity Services in England and Wales before the war: *E. Grebenik* and *D. Parry*. The Building Industry after the war: *G. D. H. Cole*.

### *Agriculture—*

*May 1943*—American impressions: *J. A. Scott Watson*.

*July 1943*—Sir Thomas Middleton: *H. E. Dale*, and *E. H. E. Havelock*. Rothamsted: 1843–1943. A New Zealander looks at British farming: *G. A. Holmes*.

*Annals of Eugenics—July 1943*—The detection of linkage. VII. Combination of data from matings of known and unknown phase: *D. J. Finney*. Place of the Australian aboriginal in the evolution of Society: *A. T. H. Jolly* and *F. G. G. Rose*.

### *The Banker—*

*May 1943*—Clearing Union or Stabilization Fund?: *Paul Einzig*. On foreigners taking advantage: *G. L. Schwartz*.

*June 1943*—The adequacy of saving. Export costs and export price policy: *N. Kaldor*. Overseas banking in 1942.

*July 1943*—Price control of consumers' goods. Eire: a financial and economic survey (articles by *S. T. O'Kelly*, *S. F. Lemass*, *J. Brennan* and others).

### *Bankers' Magazine—*

*May 1943*—Post-war currency proposals. Currency calling: *J. H. Clifford Johnston*. The Beveridge Scheme (II): *A. H. Gibson*.

*June–July 1943*. Progress of banking in Great Britain and Ireland during 1942.

*Economica—May 1943*—Comparisons of real income: *A. C. Pigou*. The expectational dynamics of the individual: *G. L. Shackle*. Multilateral clearing: *E. F. Schumacher*. Public expenditure in the National Income: *E. H. Stern*. A Liberal New Order: *A. G. B. Fisher*.

### *Economic Journal—*

*June–September 1943*—The international currency proposals: *Joan Robinson*. A commodity reserve currency: *F. A. Hayek*. The objective of international price stability: *Lord Keynes*. The industrialisation of agricultural countries: *H. Frankel*. Problems of industrialisation of Eastern and South-eastern Europe: *P. N. Rosenstein-Rodan*.

*Eugenics Review—April 1943*—The span of life: *B. S. Bramwell*.

*Institute of Bankers, Journal—July 1943*—Some reflections on international monetary organization: *A. G. B. Fisher*.

### *Institute of Statistics, Oxford, Bulletin—*

*Vol. 5, No. 7*—Distribution of the War burden: *J. L. Nicholson*. Building materials and building policy: *S. Moos*. A minimum diet in April 1943: *T. Schulz*.

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## UNITED KINGDOM—Contd.

*Institute of Statistics, Oxford, Bulletin—Contd.*

*Vol. 5, No. 8—Profits, Salaries and Wages: M. Kalecki. Point rationing of foodstuffs: K. W. Rothschild and J. Goldmann.*

*Vol. 5, No. 9—War finance in 1940, 1941 and 1942: M. Kalecki. "Human needs" cost of living for a single person: T. Schulz. Consumption of milk: J. Goldmann. Steel prices: G. D. N. Worswick.*

*Vol. 5, No. 10—Wage structure and wage policy in the U.S.A.: J. Steindl. Some new estimates of consumption: J. L. Nicholson. Coal prospects for 1943-44: F. A. Burchardt.*

*Review of Economic Studies—Summer 1943—Swedish economic policy during the war: Karin Kock. Incidence of rates on houses: M. P. Fogarty. Sources of war finance in the German war economy: H. W. Singer. The geometrical representation of complementarity: F. A. Hayek. The theory of international capital movements and its verifications: John Knapp.*

## AUSTRALIA—

*Economic Record—June 1943—Australian income tax, 1943: H. S. Carslaw. The present versus the future: J. S. G. Wilson. Price stabilization in New Zealand: H. L. Wise. The Australian coal industry: A. G. L. Shaw.*

## INDIA—

*Indian Journal of Economics—April 1943—Some comment on a dynamic theory of foreign exchanges: H. Bernadelli.*

*Sankhyā, Indian Journal of Statistics—June 1943—Some simple facts about the separation of degrees of freedom in factorial experiments: P. L. Hsu. Certain inequality relationships among the combinatorial parameters of incomplete block designs: K. R. Nair. Standardization of marking and its effects on the results of Indian Civil Service examination: P. D. Shukla and Raj Narain. Trend of profits in India: M. H. Gopal. An enquiry into the prevalence of drinking tea among middle-class Indian families in Calcutta: P. C. Mahalanobis. Note on two-fold triple systems: K. N. Bhattacharyya. A note on interaction: Q. M. Hussain. Note on the sampling error in the method of double sampling: Chameli Bose. Note on the fitting of straight lines if both the variables are subject to error: K. R. Nair and K. S. Banerjee.*

## UNION OF SOUTH AFRICA—

*South African Journal of Economics—June 1943—Old age pensions: H. R. Burrows and P. J. de Vos. A contribution to the study of the relative roles of income levels and purchasing habits in the determination of sub-standard food consumption: Edward Batson. European income distribution in the Union of South Africa and the effect thereon of income taxation: S. H. Frankel and H. Herzfeld.*

## UNITED STATES—

*Actuarial Society of America, Transactions—May 1943—Hospital Service insurance: A. Hunter and A. B. Thompson.*

*American Economic Review, June 1943—Rationing and price control in Great Britain: D. M. Keezer. Imperfect competition theory and basing point problems: J. M. Clark. Future of American dollar bonds: H. C. Wallich. Unemployment in the theories of Schumpeter and Keynes: E. G. Bennion.*

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*American Statistical Association, Journal*, June 1943—Factors in the variability of response in enumerative studies: *G. L. Palmer*. Time series significance tests based on signs of differences: *G. H. Moore* and *W. A. Wallis*. Composition of income and ownership of capital by income classes in the U.S. in 1936: *R. S. Tucker*. Comparison of demographic rates assumed by the National Resources Committee with actual experience: *R. J. Myers*. Choice of the dependent variable in regression analysis: *F. V. Waugh*. Note on a common statistical inequality: *I. H. Siegel*. Contents of Tippett's "Random sampling numbers": *R. Gage*. Quality control applied to business administration: *W. B. Rice*. Cost of living in cities in relation to their size and latitude: *E. L. Thorndike* and *E. Woodyard*. Experience with tests of significance: a reply to *Professor R. A. Fisher*: *J. Berkson*.

*Annals of Mathematical Statistics*, June 1943—On transformations used in the analysis of variance: *J. H. Curtiss*. On fundamental systems of probabilities of a finite number of events: *Kai Lai Chung*. On the efficient design of statistical investigations: *Abraham Wald*. Some significance tests for normal bivariate distributions: *D. S. Villars* and *T. W. Anderson*. Symmetric tests of the hypothesis that the mean of one normal population exceeds that of another: *H. A. Simon*. On indices of dispersion: *P. G. Hoel*. On serial numbers: *E. J. Gumbel*. Fitting general Gram-Charlier series: *P. A. Samuelson*. A method of testing the hypothesis that two samples are from the same population: *H. C. Mathisen*.

*Econometrica*, April 1943—The demand for durable goods: *C. F. Roos* and *V. S. vom Szelski*. The consumer's demand for money: *C. E. V. Leser*. Estimates of average service life and life expectancies and the standard deviation of such estimates: *Joseph Jeming*. European Exchange depreciation in the early twenties: *J. J. Polak*. Income inequality and demand studies: a note: *J. Marschak*.

*Harvard Business Review*, Summer 1943—The food situation, May, 1943: *John D. Black*. The public looks at labor unions: *Elmo Roper*. Impact of shortages on marketing: *C. F. Phillips*. Advertising when buying is restricted: *J. F. Scott*. New York City in the post-war period: *Harry Held*. Interim report on C.M.P.: *J. H. Martin*.

*Journal of Experimental Education*—

December 1942—Children's art abilities: *Thomas Munro* and others. Changes in Stanford-Binet IQ for rural consolidated and rural one-room school children: *G. M. Worbois*.

March 1943—Approximate multiple regression weights: *R. W. B. Jackson*. Characteristics of Kurtosis: *D. E. Scates*. Weighting of tests measuring the same function in terms of their length: *T. Casanova*. Machine methods of handling large classes: *J. G. Watkins*. Fisher's *t*-Test as a special case of his 2-Test: *P. J. Rulon*.

June 1943—Scholastic prediction in a teachers' college: *G. W. Durlinger*.

*Journal of Political Economy*, June 1943—Monetary policies and hoarding in periods of stagnation: *W. Fellner*. War-time concentration of production: *C. A. Myers*. The Industrial Board, precursor of the N.R.A., the price-reduction movement after World War I: *E. J. Howenstein, Jr.*

*Milbank Memorial Fund Quarterly*, June 1943—Social and psychological factors affecting fertility: *P. K. Whelpton* and *C. V. Kiser*. Are more males born in wartime? *C. Panunzio*. Maternal mortality and length of life: *A. Stevenson*.

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*Quarterly Journal of Economics*, May 1943—Mechanism of adjustment of the American balance of payments: 1919–29: *A. I. Bloomfield*. Theoretical aspects of rationing: *H. P. Neisser*. Incidence of a tax on urban real property: *H. A. Simon*. The capital budget: *J. A. Maxwell*.

*Review of Economic Statistics*, May 1943—Estimates of National output, distributed income, consumer spending, saving and capital formation: *M. Hoffenburg*.

*Social Research*, May 1943—Commercial policy between the two wars: *R. Schiller*. Industrial concentration versus small business—the trend of Nazi policy: *Herbert Block*. The Beveridge Plan (Note): *Frieda Wunderlich*.

*Wheat Studies of the Food Research Institute*, May 1943—World wheat survey and outlook.

## MEXICO—

*Estadística (Journal of the Inter-American Statistical Institute)* No. 2, June 1943—Completeness of birth registration in the United States: *H. L. Dunn* and *R. D. Grove*. Las características culturales de los censos mexicanos: *F. Rojas González*. O Instituto Geográfico e Estatístico e os problemas de base do Brasil: *M. A. Texeira de Freitas*. The International Statistical Congress, 1853–1878: *W. F. Willcox*. El censo de poblacion de 1940 de la República de Panama: *Georgina Jiménez*. Estadísticas comparadas—Chile–Peru: *C. P. Jiménez Correa*. Government standards of sampling practice in the United States: *W. E. Deming* and *M. Gurney*. The special war-time activities of a Central Statistical Bureau: *S. A. Cudmore*. La riqueza de Mexico (notas complementarias): *E. A. Patiño*.

## INTERNATIONAL—

*International Labour Review*—

May 1943—Chinese economic policy in war-time: *General Yao Tsu Ho*. Soviet workers in Germany. Social Security planning in Canada.

June 1943—Men's and women's wages in the United States: *Z. Clark Dickinson*. Planning of medical services in Australia.

July 1943—The transition from war to peace economy: analysis of an international report: *E. J. Riches* and *L. B. Jack*. Rates of pay and working hours of seafarers: conditions in four Merchant Navies. Conditions of work of hospital employees in the United States.

*International Review of Agriculture*, March 1943—The small holding: its creation and problems: *G. Costanzo*. Yearly fluctuations of cereals yields in Europe: *V. Dore*. Evolution of the cocoa market: *W. Schubring*.

## LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part I 1943, the Society has received the publications enumerated below :—

## I.—OFFICIAL PUBLICATIONS

## (a) United Kingdom.

- Agricultural Research Council.* The diagnosis of mineral deficiencies in plants by visual symptoms: a colour atlas and guide. *T. Wallace.* London: H.M.S.O., 1943.  $9\frac{1}{2}" \times 6"$ . vi + 116 pp. 10s.
- Agriculture and Fisheries, Ministry of.* Farm book-keeping. London: H.M.S.O., 1943.  $8\frac{3}{4}" \times 5\frac{1}{2}"$ . 20 pp. 3d.
- Colonial Office.* Labour supervision in the colonial empire, 1937–43. London: H.M.S.O., 1943. Colonial No. 185.  $9\frac{1}{2}" \times 6"$ . 26 pp. 6d.
- Dominions Office.* Tentative draft proposals of Canadian experts for an International Exchange Union. Tabled in the Canadian House of Commons by the Minister of Finance on July 12th, 1943. Reprinted by H.M.S.O., London, 1943.  $9\frac{1}{2}" \times 6"$ . 19 pp. 3d.
- Education, Board of.*
- Abolition of tuition fees in grant-aided secondary schools: special report of the Committee on Public Schools appointed by the President of the Board of Education in 1942. London: H.M.S.O., 1943.  $9\frac{1}{2}" \times 6"$ . 43 pp. 6d.
  - Curriculum and examinations in secondary schools: report of the Committee of the Secondary Examinations Council appointed by the President of the Board of Education in 1941. London: H.M.S.O., 1943.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . ix + 151 pp. 1s. 6d.
  - Educational reconstruction. London: H.M.S.O., 1943. Cmd. 6458.  $9\frac{1}{2}" \times 6"$ . 36 pp. 6d.
  - The youth service after the war: a report of the Youth Advisory Council appointed by the President of the Board of Education in 1942 to advise him on questions relating to the youth service in England. London: H.M.S.O., 1943.  $9\frac{1}{2}" \times 6"$ . 32 pp. 6d.
- Fuel and Power, Ministry of.* Coal-dust explosions: special report by The Safety in Mines Research Board. London: H.M.S.O., 1943. Cmd. 6450.  $9\frac{1}{2}" \times 6"$ . 14 pp. 3d.
- Health, Ministry of.*
- National Health Insurance. Fifth valuation of the assets and liabilities of approved societies: summary report by the Government Actuary with a supplement on additional benefit schemes. London: H.M.S.O., 1943. Cmd. 6455.  $9\frac{1}{2}" \times 6"$ . 12 pp. 2d.
  - Report of Midwives Salaries Committee: salaries and emoluments of institutional and domiciliary midwives, non-medical supervisors of midwives and of pupil midwives. London: H.M.S.O., 1943. Cmd. 6460.  $9\frac{1}{2}" \times 6"$ . 37 pp. 6d.
  - Third report of the Central Advisory Water Committee: river boards. London: H.M.S.O., 1943. Cmd. 6465.  $9\frac{1}{2}" \times 6"$ . 73 pp. 1 map. 1s. 3d.
- Imperial Agriculture Bureau.* Report on the Imperial Agriculture Bureaux: by a Committee under the chairmanship of the Rt. Hon. Lord Hankey. 1943. London: H.M.S.O., 1943.  $9\frac{3}{4}" \times 7\frac{1}{4}"$ . 38 pp. 1s. 6d.
- Industrial Health Research Board.* A study of absenteeism among women by *S. Wyatt, R. Marriott and D. E. R. Hughes* (Emergency Report No. 4). London: H.M.S.O., 1943.  $9\frac{1}{2}" \times 6"$ . 12 pp. 2d.
- Labour and National Service, Ministry of, and Ministry of Production.* Production and engineering bulletin. Vol. 2. Nos. 1–9. London: 1942–3.  $9\frac{1}{2}" \times 7\frac{1}{4}"$ . 9 parts.
- Lord Chancellors Department.* Report of the Land Transfer Committee. London: H.M.S.O., 1943. Cmd. 6467.  $9\frac{1}{2}" \times 6"$ . 9 pp. 2d.



## (a) United Kingdom—Contd.

*Medical Research Council.*

Chronic Pulmonary disease in South Wales coal miners. II.—Environmental studies. A.—Report by the committee on industrial pulmonary disease. B. C. —Reports on physical, chemical, and petrological studies . . . (Special report Series, No. 244.) London: H.M.S.O., 1943. 9½" 6". xi + 222 pp. 10s. 6d.

The medical use of sulphonamides. (War Memorandum No. 10.) London: H.M.S.O., 1943. 9½" 6". 45 pp. 9d.

*Pensions, Ministry of.* Changes in war pensions. London: H.M.S.O., 1943. Cmd. 6459. 9½" 6". 12 pp. 2d.

*Production, Ministry of.* The production authorities guide June 1943. London: H.M.S.O., 1943. 9½" 6". 20 pp. 4d.

*Select Committee on National Expenditure.*

Session 1942–1943. Reports: 7th. Replies from departments to recommendations in reports. 19 pp. 4d. 8th. Fuel and power. 11 pp. 2d. 9th. Replies from departments to recommendations in reports. 36 pp. 6d. 10th. Aircraft production. 20 pp. 4d. 11th. The War Office Claims Commission. 8 pp. 2d. London: H.M.S.O., 9½" 6". 5 parts.

War damage to public utility undertakings, Section 40 of the War Damage Act 1941. London: H.M.S.O., Cmd. 6403. 9½" 6". 14 pp. 3d.

## (b) British Empire.

**New Zealand—**

*National Service Department.* Reports of the National Service Department and of the Industrial Man-power Division on the activities of the National Service Department under the National Service Emergency Regulations 1940, the Emergency Reserve Corps Regulations 1941, and the Industrial Man-power Emergency Regulations 1942. Wellington: 1943. 13½" x 8½". 60 pp.

**Southern Rhodesia—**

Report of the Director of Census on the census of population, 1936. Salisbury: 1943. 13" 8". ii + 287 pp.

**Union of South Africa—**

Sixth census of the population of the Union of South Africa, enumerated 5th May, 1936. Volume V birthplaces, period of residence and nationality of the European, Asiatic and coloured population. Pretoria: 1942. 12" 9½". xxxviii + 151 pp. 7s. 6d.

## (c) Foreign Countries.

**Poland—**

*Polish Ministry of Information.* Concise statistical year-book of Poland. September 1939–June 1941. London: 1941. 6½" 4½". xvi + 160 pp. (From Dr. Ludwik Grozicki.)

**Portugal—**

*Instituto Nacional de Estatística.* VIII recenseamento geral da população no continente e ilhas adjacentes em 12 de dezembro de 1940. Vol. II Distrito de Aveiro. 1942. 318 pp. Vol. III Distrito de Beja. 1943. 256 pp. Lisboa: 12" 9½".

**United States of America—**

*Department of Agriculture.* Family spending and saving as related to age of wife and age and number of children by D. Monroe, M. Y. Pennell, M. R. Pratt, G. S. De Puy. (Miscellaneous Publication 489.) Washington, 1942. 10½" 8". 126 pp.

*Children's Bureau.* Births, infant mortality, maternal mortality: graphic presentation 1940. (Children's Bureau Publications No. 288.) Washington: 1943. 7½" x 10½". 71 pp. \$1.

## (d) International.

## International Labour Office—

- The co-operative movement in the Americas: an international symposium. . . .  
 Montreal: I.L.O., 1943. 9" x 6". 59 pp. 1s.  
 Labour problems in Bolivia: report of the Joint Bolivian-United States Labour  
 Commission. English and Spanish texts. Montreal: 1943. 9" x 6". 105  
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 Merchant Seamen and the War: record of the twelfth session of the Joint Maritime  
 Commission. London, 26-30 June 1942. (Studies and Reports Series P, No.  
 5.) Montreal: 1943. 9" x 6". 154 pp. 4s.

## League of Nations—

*Economic and Financial and Transit Department.*

- Europe's overseas needs 1919-1920 and how they were met. (II. Economic and  
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 Quantitative trade controls; their causes and nature. (II. Economic and  
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## II.—AUTHORS AND MISCELLANEOUS

- Brandt (Karl)*. Fats and oils in the war. (War-Peace Pamphlets No. 2.) Stanford  
 University: Food Research Institute, 1943. 8½" x 6". 60 pp. 25c.  
*Coats (R. H.) and Maclean (M. C.)*. The American-born in Canada: a statistical  
 interpretation. (The relations of Canada and the United States: a series of studies  
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 don: Humphrey Milford.) 9½" x 6½". xviii + [1] pp. 2 maps.  
*Davies (Joseph S.)*. War-time food management: an analysis with recommendations.  
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 August 11th, 1943. 9" x 6". 46 pp.  
*Economist (The)*, 1843-1943: a centenary volume. London: Oxford University  
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*Fehr, Frank, & Co.* Review of the oilseed, oil and oil cake markets for 1929, 1931,  
 1932, 1936, 1937, 1939, 1940, 1941. London. 10½" x 8½". 8 vols. (From Frank  
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 xiv + 224 pp. 15s.  
*Grebenik (E.) and Parry (Dorothy J.)*. The maternity services in England and Wales  
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 132 pp.  
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*Kendall (Maurice G.)*. The advanced theory of statistics. Volume 1. London:  
 Charles Griffin, 1943. 10" x 8". xii + 457 pp. 42s.  
*Koch (Albert Ralph)*. The financing of large corporations 1920-39. (Studies in  
 Business Financing.) New York: National Bureau of Economic Research. 1943.  
 9" x 6½". [2] + 139 pp. \$1.50.

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- Kuczynski (Jürgen)*. A short history of labour conditions under industrial capitalism. Volume two: The United States of America 1789 to the present day. London: Frederick Muller, Ltd., 1943. 7½" × 5". 228 pp. 10s. 6d.
- Lotka (Alfred J.)*. On an integral equation in population analysis. [83.] (Repr. from *Annals of Mathematical Statistics*. June 1939.) 10" 7". 18 pp.
- Sur une équation intégrale de l'analyse démographique et industrielle. [85.] (Extrait du *Bulletin de l'Association des Actuaire suisses*. l'asc. 40-15, octobre 1940.) Berne: 1940. 9" × 6". 16 pp.
- The law of urban concentration. [87.] (Repr. from *Science*, Aug. 15th, 1941.) 9" × 6". 1 p.
- The progeny of an entire population. [88.] (Repr. from *Annals of Mathematical Statistics*. June, 1942.) 10" 7". [12 pp.]
- Some reflections—statistical and other—on a non-material universe. [89.] (Repr. from *Journal of the American Statistical Association* March, 1943, Vol. 38, pp. 1-15.) 9" × 6".
- The place of the intrinsic rate of natural increase in population analysis. [90.] (Repr. from Volume VIII, *Proceedings of the 8th American Scientific Congress*, May, 1940. 9½" × 7½".) [17 pp.]
- and *Spiegelman (Mortimer)*. The trend of birth rate by age of mother and order of birth. [86.] (Repr. from *Journal of the American Statistical Association* Dec., 1940, Vol. 35, pp. 595-601.) 9½" × 6".
- Lutz (Friedrich A.)*. International monetary mechanisms: The Keynes and White proposals. (Essays in International Finance No. 1, July 1943.) Princeton, N.J.: International Finance Section, Dept. of Economics and Social Institutions Princeton University, 1943. 9" × 6". 21 pp.
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- Pavlowitch (K. Sr.)*. The struggle of the Serbs. London: The Standard Art Book Co. 1943. 7½" × 5". xii + 78 pp. 1 map. (From the author.)
- Rissik (H.)*. Quality control in production engineering. Sampling inspection and quality determination. (Repr. from *Aircraft Engineering*, Feb. June 1943. 12" × 9½". 21 pp.) (From the author.)
- Sermon (Joseph)*. Integral accounting: an authentic treatise on the integration of cost accounting and normal accounting. Potters Bar: Gee & Co., London: City Library, 1943. 8½" × 5½". xv + 52 pp. Appendix 47 pp.
- Smithsonian Institution. Are wars inevitable? by John R. Swanton. (War background Studies No. 12. Publication 3730.) Washington: 1943. 9" 6". iii + 36 pp.
- Staples (Ronald)*. Staples on back duty: being a consideration of the law and practice relating to the settlement of liability to income tax, sur-tax, excess profits duty, national defence contribution, excess profits tax, interest and penalties where income has escaped assessment tax at the proper time. 4th ed. Potters Bar: Gee & Co. London: City Library, 1943. 8½" × 5½". 135 pp. 21s.
- Sturzenegger (E.)*. The Rand gold mines: 13th annual edition, 1943. London: E. Sturzenegger, Palmerston House, E.C.2, 1943. 6½" × 4½". 307 pp. 25s. (From the author.)
- Thomson (Godfrey)*. The factorial analysis of human ability. London: University of London Press, 1939. 8½" × 6". xv + 326 pp. 16s.
- Titmuss (Richard M.)*. Birth, poverty and wealth: a study of infant mortality. London: Hamish Hamilton Medical Books, 1943. 7½" × 4½". 118 pp. 7s. 6d.

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- Truesdell (Leon E.)*. The Canadian born in the United States: an analysis of the statistics of the Canadian element in the population of the United States 1850–1930. (The relations of Canada and the United States.) New Haven: Yale University Press. For the Carnegie Endowment for International Peace: Division of Economics and History, 1943 (London: Humphrey Milford).  $9\frac{1}{2}'' \times 7''$ . xvi + 1 + 263 pp. 20s.
- Vakil (C. N.)*. Financial burden of the war on India. Bombay: By the author, 1943.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . xii + iii + 140 pp. 6s.
- Walker (Gilbert)*. Road and rail: an enquiry into the economics of competition and state control. London: Allen and Unwin, 1942.  $8\frac{1}{2}'' \times 5\frac{3}{4}''$ . 236 pp. 12s. 6d.
- Wharton (A. S.)*. Statistics and quality control. London: Published for Circulation amongst the Phillips Group of Companies, 1943.  $8'' \times 6\frac{1}{2}''$ . 4 + 60 pp. (From the author.)
- Wilks (S. S.)*. Mathematical Statistics. Princeton, N.J.: Princeton University Press, 1943. (London: Sir Humphrey Milford.)  $10\frac{3}{4}'' \times 8\frac{1}{2}''$ . xi + 284 pp. 25s.

## REGISTRATION OF THE UNITED KINGDOM

## No. I.—ENGLAND AND WALES

A.—BIRTHS, DEATHS, and MARRIAGES in the Calendar years 1938-1942 and in the Quarters of those years. Numbers and Annual Rates per 1000 persons living; (Deaths under 1 year of age: rate per 1000 Live Births; Stillbirths per 1000 Births.)

Years	1938		1939		1940 *		1941 *		1942 *	
Estimated Mid-Year Popln. in thousands	11,215		11,160							
	Number	Rate	Number	Rate	Number	Rate†	Number	Rate†	Number	Rate
Live Births ...	621,201	55.1	619,352	55.9	607,029	54.6	587,225	51.7	655,075	58.8
Stillbirths ...	21,729	0.60	21,309	0.59	22,731	0.55	20,902	0.50	22,250	0.54
Deaths ...	175,629	15.6	190,504	17.1	581,537	51.0	555,180	48.9	179,507	16.0
Marriages ...	361,768	32.3	439,894	39.4	170,540	15.3	387,510	34.1	268,252	23.9
Infant Mortality ...	32,473	5.3	30,927	5.0	33,638	5.5	31,292	5.0	32,260	5.1
Quarters	Live Births in the Quarters of each Calendar Year									
Jan.-Mar. ...	155,157	13.8	153,382	13.8	151,315	13.6	147,027	13.1	158,201	14.1
Apr.-June ...	184,179	16.4	181,306	16.3	166,686	14.9	147,111	13.2	167,557	15.0
July-Sept. ...	158,082	14.1	161,023	14.5	119,092	10.7	147,021	13.1	168,638	15.1
Oct.-Dec. ...	113,766	10.2	140,641	12.6	136,906	12.3	145,166	12.9	160,079	14.4
	Stillbirths									
Jan.-Mar. ...	6,185	0.61	6,295	0.62	6,223	0.60	5,632	0.55	5,636	0.55
Apr.-June ...	6,639	0.65	6,362	0.62	5,991	0.58	5,107	0.52	5,752	0.56
July-Sept. ...	6,072	0.58	5,916	0.57	5,371	0.54	4,970	0.48	5,125	0.52
Oct.-Dec. ...	5,838	0.56	5,706	0.55	5,143	0.49	4,800	0.47	5,167	0.52
	Deaths (excluding Stillbirths) †									
Jan.-Mar. ...	137,897	12.3	151,232	13.6	205,183	18.9	178,637	15.5	151,070	13.5
Apr.-June ...	119,188	10.6	120,529	10.8	119,706	10.7	110,186	9.6	116,831	10.4
July-Sept. ...	109,545	9.8	103,300	9.3	111,733	10.0	101,336	9.0	97,276	8.7
Oct.-Dec. ...	119,189	10.7	121,743	10.9	144,915	13.0	115,021	10.0	111,727	10.0
	Marriages									
Jan.-Mar. ...	52,159	4.6	47,121	4.2	109,322	9.8	80,719	7.2	88,222	7.9
Apr.-June ...	102,280	9.1	102,816	9.2	116,700	10.5	105,200	9.3	100,925	9.0
July-Sept. ...	116,539	10.4	162,980	14.6	131,894	11.8	101,333	9.0	96,713	8.6
Oct.-Dec. ...	90,780	8.1	186,827	16.8	112,633	10.1	97,256	8.6	83,392	7.5
	Infant Mortality									
Jan.-Mar. ...	10,523	6.8	9,978	6.5	11,876	7.7	10,985	7.5	9,697	6.1
Apr.-June ...	7,933	4.8	7,828	4.8	7,681	6.0	6,712	5.0	7,820	4.7
July-Sept. ...	6,510	4.1	6,354	4.0	6,316	5.5	6,411	4.3	6,766	4.0
Oct.-Dec. ...	7,477	5.2	6,763	4.9	7,765	5.7	8,181	5.0	7,713	4.8

\* Provisional figures.

† Excluding deaths of non-civilians after 2 Sept., 1939.

‡ Provisional rates based upon Mid-1939 population. Changes in total population since 1939 are not sufficient to invalidate these rates to any serious extent

## No. II.—SCOTLAND

BIRTHS, DEATHS, and MARRIAGES in the Calendar years 1938–1942 and in the Quarters of those years. Numbers and Annual Rates per 1,000 persons living; (Deaths under 1 year of age: rate per 1,000 Live Births; Stillbirths per 1,000 Births.)

Years	1938		1939 *		1940 *		1941 *		1942 *	
Estimated Mid-Year Popln. in thousands	4,985		5,010							
	Number	Rate	Number	Rate †	Number	Rate †	Number	Rate †	Number	Rate †
Live Births ...	88,627	17.7	86,899	17.4	86,403	17.2	89,713	17.9	90,691	18.1
Stillbirths ...	Not separately recorded		3,852	4.2	3,796	4.2	3,689	3.9	3,593	3.8
Deaths ...	62,053	12.6	61,113	12.2	72,775	14.5	72,552	14.5	64,902	13.0
Marriages ...	35,747	7.8	46,237	9.2	53,507	10.7	47,717	9.5	47,512	9.5
Infant Mortality ...	6,163	7.0	5,955	6.9	6,766	7.8	7,126	8.3	6,224	6.9
Quarters										
LIVE BIRTHS in the Quarters of each Calendar Year										
Jan.-Mar. ...	22,315	18.1	21,429	17.4	22,113	17.8	22,254	18.0	21,581	17.7
Apr.-June ...	23,099	19.3	23,615	18.0	25,298	18.7	23,123	18.8	21,111	16.3
July-Sept. ...	21,123	17.0	21,519	17.1	21,151	16.8	22,666	18.0	22,526	17.5
Oct.-Dec. ...	20,960	16.7	20,306	16.1	19,538	15.8	21,410	17.0	22,051	17.5
Stillbirths										
Jan.-Mar. ...	—	—	958	4.3	1,017	4.4	1,034	4.4	970	4.2
Apr.-June ...	—	—	979	4.0	958	3.9	958	3.9	927	3.7
July-Sept. ...	—	—	990	4.4	917	4.2	867	3.7	883	3.6
Oct.-Dec. ...	—	—	905	4.3	904	4.4	830	3.7	863	3.8
Deaths (excluding Stillbirths)										
Jan.-Mar. ...	17,448	14.2	18,905	15.4	25,936	20.8	23,333	18.9	19,441	15.7
Apr.-June ...	15,603	12.5	15,672	12.6	16,062	12.9	18,090	15.2	16,267	13.1
July-Sept. ...	13,807	11.0	15,587	10.8	11,200	11.2	14,464	11.5	13,784	10.9
Oct.-Dec. ...	16,095	12.8	16,159	12.8	16,628	13.2	16,763	12.5	15,410	12.2
Marriages										
Jan.-Mar. ...	7,885	6.4	7,662	6.2	12,005	9.6	10,754	8.7	12,713	10.3
Apr.-June ...	9,420	7.6	9,960	8.0	12,971	10.4	12,383	9.9	12,228	9.8
July-Sept. ...	11,893	9.4	15,620	12.4	15,625	12.4	15,078	10.4	11,917	9.4
Oct.-Dec. ...	9,618	7.6	13,015	10.3	12,996	10.3	11,592	9.1	10,610	8.4
Infant Mortality										
Jan.-Mar. ...	1,790	8.0	1,800	8.8	2,474	11.2	2,435	10.9	1,961	9.0
Apr.-June ...	1,563	6.5	1,412	6.1	1,568	6.7	1,965	8.4	1,544	6.4
July-Sept. ...	1,253	5.8	1,220	5.7	1,215	5.7	1,424	6.3	1,322	6.0
Oct.-Dec. ...	1,577	7.5	1,103	6.9	1,509	7.6	1,602	7.5	1,157	6.6

\* Provisional figures.

† Based upon estimated population, Mid-1939.

## No. III.—NORTHERN IRELAND

BIRTHS, DEATHS, and MARRIAGES in the Calendar years 1938–1942 and in the Quarters of those years. Numbers and Annual Rates per 1,000 persons living: (Deaths under 1 year of age—rate per 1,000 Live Births.)

Years	1938		1939		1940		1941 *		1942 *	
Estimated Mid-Year Popln. in thousands	1,280		1,295		1,296		1,285		1,301	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	25,743	20.0	25,210	19.5	25,363	19.6	26,987	20.8	29,653	22.8
Stillbirths ...	Not separately recorded									
Deaths ...	17,619	13.7	17,512	13.5	18,911	14.6	19,610	15.2	17,256	13.3
Marriages ...	8,617	6.70	9,185	7.1	9,795	7.5	11,966	9.3	11,701	9.0
Infant Mortality ...	1,933	7.5	1,779	7.0	2,179	8.6	2,059	7.7	2,259	7.6
Quarters	Live Births in the Quarters of each Calendar Year									
Jan.-Mar. ...	6,286	19.6	6,231	19.3	6,167	20.0	6,206	19.3	6,731	21.0
Apr.-June ...	6,903	21.5	6,859	21.2	7,091	21.9	7,232	22.5	7,990	24.7
July-Sept. ...	6,515	20.3	6,310	19.6	6,331	19.5	7,047	22.0	7,435	24.1
Oct.-Dec. ...	6,040	18.8	5,821	18.0	5,490	16.9	6,361	19.8	7,097	21.8
	Deaths (excluding Stillbirths).									
Jan.-Mar. ...	5,153	16.0	5,350	16.5	6,597	20.4	6,183	19.3	5,168	16.1
Apr.-June ...	4,283	13.3	4,371	13.5	4,591	14.2	5,753	17.9	4,287	13.2
July-Sept. ...	3,799	11.8	3,686	11.4	3,789	11.6	3,741	11.6	3,639	11.2
Oct.-Dec. ...	4,416	13.7	4,142	12.8	3,991	12.3	3,985	12.4	4,163	12.8
	Marriages									
Jan.-Mar. ...	1,599	5.0	1,432	4.4	2,101	6.5	2,099	6.5	2,460	7.7
Apr.-June ...	2,229	6.9	2,200	6.8	1,979	6.1	3,033	9.4	3,211	9.9
July-Sept. ...	2,602	8.1	2,559	7.9	2,976	9.2	3,837	11.9	3,406	10.5
Oct.-Dec. ...	2,157	6.7	2,637	8.1	2,511	7.8	2,959	9.2	2,627	8.1
	Infant Mortality									
Jan.-Mar. ...	668	10.6	599	9.6	680	10.7	563	9.1	652	9.7
Apr.-June ...	455	6.6	448	6.5	601	8.5	518	7.2	569	7.1
July-Sept. ...	368	5.6	316	5.5	481	7.6	467	6.6	511	6.5
Oct.-Dec. ...	436	7.2	381	6.7	403	7.3	509	8.0	527	7.4

\* Provisional figures.

## No. IV.—EIRE

BIRTHS, DEATHS, and MARRIAGES in the Calendar Years 1938–1942 and in the Quarters of those years. Numbers and Annual Rates per 1,000 persons living (Deaths under 1 year of age—rate per 1,000 Live Births.)

Years	1938		1939		1940		1941		1942 *	
Estimated Mid-Year Popln. in thousands	2,937		2,934		2,958		2,990			
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	56,925	19.4	56,070	19.1	56,504	19.1	56,780	19.0	65,972	22.3
Stillbirths ...	Not separately recorded									
Deaths ...	40,041	13.6	41,717	14.2	41,885	14.2	43,797	14.6	41,619	14.0
Marriages ...	14,893	5.1	15,204	5.2	15,212	5.1	15,021	5.0	17,436	5.9
Infant Mortality ...	3,794	67	3,691	66	3,759	66	4,175	74	4,517	68
Quarters	Live Births in the Quarters of each Calendar Year									
Jan.–Mar. ...	14,083	19.2	14,215	19.4	14,081	19.0	13,673	18.3	11,365	19.4
Apr.–June ...	11,697	20.0	11,475	19.7	15,151	20.5	11,955	20.0	15,177	24.5
July–Sept. ...	14,768	20.1	11,262	19.4	14,385	19.5	15,067	20.2	17,735	23.9
Oct.–Dec. ...	13,377	18.2	13,088	17.8	12,991	17.6	13,085	17.5	15,695	21.2
	Deaths (excluding Stillbirths)									
Jan.–Mar. ...	11,412	15.6	13,313	18.1	13,361	18.1	14,653	19.6	12,103	16.3
Apr.–June ...	9,814	13.4	10,372	14.1	10,181	14.2	11,312	15.1	10,811	14.6
July–Sept. ...	8,587	11.7	8,600	11.7	8,442	11.4	8,679	11.6	8,524	11.5
Oct.–Dec. ...	10,198	13.9	9,432	12.9	9,601	13.0	9,153	12.2	10,181	13.7
	Marriages									
Jan.–Mar. ...	3,824	5.2	3,487	4.8	3,503	4.7	3,520	4.7	4,007	5.4
Apr.–June ...	3,435	4.7	3,665	5.0	3,808	5.1	3,643	4.9	4,616	6.2
July–Sept. ...	4,379	6.0	4,514	6.2	4,592	6.2	4,202	5.6	5,041	6.8
Oct.–Dec. ...	3,255	4.4	3,538	4.8	3,309	4.5	3,656	4.9	3,792	5.1
	Infant Mortality									
Jan.–Mar. ...	1,155	81	1,173	82	1,103	78	1,151	84	1,144	80
Apr.–June ...	946	64	932	64	951	63	1,080	72	1,131	62
July–Sept. ...	810	55	754	53	735	51	976	65	1,014	57
Oct.–Dec. ...	883	66	832	64	967	75	968	74	1,228	78

\* Provisional figures.



## No. V.—GREAT BRITAIN AND IRELAND

SUMMARY OF BIRTHS, DEATHS, AND MARRIAGES in the years 1939–1942: *Numbers and Rates per 1,000 persons living. (Deaths under 1 year of age Mortality per 1,000 Live Births.)*

(Compiled from the Quarterly Returns of the respective Registrars General)

	England and Wales	Scotland	Northern Ireland	United Kingdom	Ire
Area in statute acres (thousands) ...	37,310	19,162	3,188	60,290	17,251
1939					
Population (in thousands) ...	41,160	5,010	1,295	47,465	2,934
Births ...	619,352	86,899	25,210	731,461	56,070
Birth rates ...	14.9	17.4	19.5	15.4	19.1
Deaths ...	499,801	61,113	17,512	581,759	11,117
Death rates ...	12.1	12.0	13.5	12.2	14.3
Marriages ...	439,691	46,257	9,185	495,136	15,201
Marriage rates ...	10.6	9.2	7.1	10.3	5.2
Deaths under 1 year ...	30,927	5,955	1,779	38,661	3,691
Infant Mortality rates ...	50	69	70	51	66
1940					
Population (in thousands) ...	41,460 *	5,010 *	1,296	47,766	2,958
Births ...	607,929	86,103	25,363	719,395	56,691
Birth rates ...	14.6	17.3	19.6	15.0	19.1
Deaths ...	581,537	72,775	18,911	673,253	11,886
Death rates ...	14.0	14.0	14.6	14.0	14.2
Marriages ...	470,549	53,597	9,795	534,659	15,212
Marriage rates ...	11.3	10.6	7.5	11.1	5.1
Deaths under 1 year ...	33,638	6,766	2,179	42,583	3,759
Infant Mortality rates ...	55	78	80	59	66
1941					
Population (in thousands) ...	41,460	5,010 *	1,285	47,750	2,990
Births ...	587,228	89,713	26,887	703,858	56,780
Birth rates ...	14.2	17.9	20.9	14.7	19.0
Deaths ...	535,180	72,558	19,618	627,356	11,797
Death rates ...	12.9	14.5	15.3	13.1	14.7
Marriages ...	587,510	17,717	11,966	617,193	15,021
Marriage rates ...	14.2	3.5	9.3	12.9	5.1
Deaths under 1 year ...	31,292	7,126	2,059	40,477	1,175
Infant Mortality rates ...	59	83	79	62	11
1942					
Population (in thousands) ...	41,160 *	5,010 *	1,301	47,471	2,912
Births ...	655,075	90,691	29,653	775,422	65,912
Birth rates ...	15.8	18.1	22.9	16.3	22.6
Deaths ...	179,907	61,962	17,256	259,125	11,619
Death rates ...	4.3	12.4	13.3	5.5	14.0
Marriages ...	568,252	17,512	11,701	607,465	17,166
Marriage rates ...	13.8	3.5	9.0	12.8	5.9
Deaths under 1 year ...	32,280	6,284	2,259	40,823	1,817
Infant Mortality rates ...	51	69	76	52	68

\* Mid-1939 estimate. See No. 1, England and Wales, (footnote).

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## CORRIGENDA

### PART II 1943

Page 196. Line 4 of heading : for *Births* read *Population*.

Page 200. Scotland. Death rate 1940 *read* 14·5.  
,, Marriage rate 1940 *read* 10·7.

Northern Ireland. Birth rate 1941 *read* 20·8.  
,, No. of deaths 1941 *read* 19,640.  
,, Infant mortality 1941 *read* 77.

United Kingdom. No. of deaths 1941 *read* 626,378.



# JOURNAL OF THE ROYAL STATISTICAL SOCIETY

## PART III, 1943

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### POST-WAR INTERNATIONAL MONETARY PLANS

A DISCUSSION BEFORE THE ROYAL STATISTICAL SOCIETY, ON MAY 18TH, 1943,  
MR. H. LEAK, C.B.E., IN THE CHAIR

Opened by MR. NORMAN CRUMP

IN discussing a question which involves international relations one feels a certain sense of responsibility, but in intimate proceedings such as ours there is an even greater need for a certain degree of outspokenness, and I hope our American visitors will be equally outspoken. It is only by thrashing out the details of these proposals in an entirely frank manner that we can arrive at something workable.

We have before us two main plans, the British plan associated with the name of Lord Keynes, and the American plan known as the White plan. I have also within the past few hours seen some suggestions from the French. I have not had time to go through these, but mention them because it must be borne in mind that we have no right to approach these problems solely from the British or American standpoint. We have to give complete weight to the views of each and all of the United Nations.

I am going to deal with this question under four headings: the general approach, the mechanics, the limitations, and future procedure. On the approach side we have a general recognition of the problem that if trade is to revive after the war we must have reasonable stability but not absolute rigidity of exchange rates. It is also recognized that if international trade is to be revived after the war every country must try to get its imports and exports to balance at the highest, and not at the lowest, possible level. Thirdly, we recognize that because of the war, and for other reasons too, there is to-day and will be immediately after the war a serious maladjustment throughout the world of existing gold and foreign exchange reserves and also of short-term liabilities.

There are three angles of approach: (1), to use a term coined by *The Economist*, the angle of approach of a surplus nation—the United States and certain British Dominions; (2) the British angle of approach, that of a nation which is for the moment a deficit nation, but which has been a surplus nation and hopes to be again a surplus nation; (3) the deficit nations—deficit in many cases through no fault of their own. For the few years immediately following the war we must include amongst them those countries of Europe and the Far East now under enemy occupation.

It is this difference in circumstances which, I suggest, explains the difference in the angle of approach to the main problem which one finds in the Keynes plan and in the White plan. The White plan, the approach of a surplus nation, starts from the standpoint of limited commitments. It recognizes as a fact that

the surplus nations will be asked in the first place to grant facilities and accommodation to the deficit nations through the mechanism of these plans, but there is a natural feeling that a surplus nation will have to be a little careful how many blank cheques it hands out. The Keynes plan, from the standpoint of a deficit nation, sees that one of the first things to do is to get world trade going again in the greatest possible volume and at the highest possible level. That is why the Keynes plan starts with the idea of manufacturing international money, as and when it is needed.

The basic idea of the White plan is this: let all the United Nations club together here and now to start an international shop with a certain amount of gold, but mainly with their own currencies and securities. Let us begin by defining how much stock-in-trade each nation is expected to find in these ways for the new shop. Let us say that of the stock-in-trade provided by each nation, 50 per cent. must go into the shop—that is, be put in the windows—and the other 50 per cent. be held in reserve.

The Keynes plan says: Let us set up a factory, and as and when the product of that factory—the Keynes international medium, *bancor*—is wanted, let us manufacture it; and let us further say that *bancor* shall be international legal tender in the sense that every debtor can compel his creditor to accept it. But at the same time let us set two bounds to this manufacturing process: (1) that after a certain limit, dependent upon the fixed quota for each nation, has been reached to either the debit or credit *bancor* balance held by a nation, it has to pay interest on the excess at the rate of 1 per cent.; (2) that there should be further controls over a nation's right to overdraw beyond the limit. The Keynes plan goes still further. It prescribes certain steps which are to be recommended if a nation accumulates too big a credit balance; and it establishes the vital principle that a persistently surplus nation has its responsibilities to the world at large, just as much as a persistently deficit nation.

There is, I agree, a mention of the duties of a surplus nation in the White plan. I equally agree that both plans recognize the difficulty of disciplining the persistently surplus nation. It is a difficulty which I can best explain in this way: if at your bank you were persistently running an overdraft beyond the limits of what your bank manager approved, he would sooner or later pull you up; but if you persistently ran a big credit balance on your bank, there is very little that your bank manager could do about it.

I come next to the mechanism of the two plans. Let me begin with the mechanism of ordinary international payments. Suppose that I gave the Chairman a cheque for £5, which he paid into his bank. My bank would lose £5 out of its total deposits due to its customers; and it would also lose £5 out of its cash as represented by its balance at the Bank of England. Conversely, the Chairman's bank would show an increase of £5 in its total deposits and also one of £5 in its cash as represented by the balance at the Bank of England. But it is obvious that at the central bank—that is the Bank of England—the total of bankers' deposits would remain unchanged.

Under the Keynes plan what might happen in the international sphere is this: the importer (or his bank) buys a *bancor* draft from his central bank, remits it to the exporter, who pays it into his commercial bank, which turns it over to the central bank. Therefore in the exporting country you get an increase in commercial bank deposits and cash, and also an increase in member bank balance at the central bank. The offset to the last-named will be an increase

in the *bancor* assets held by that central bank. In the importer's country you get a drop in the first three items. The offsetting item at the central bank would be an increase in the *bancor* overdraft shown among the liabilities of that central bank.

That is simple enough. In the White plan there are two processes. First of all, the shop has to be stocked initially and a certain amount, say a minimum of 5 per cent. of the stock-in-trade, has to be in gold. (What of the countries which to-day have no gold at all?) The rest can be currency and securities, and these can be created for the purpose, just as we did in this country when twelve years ago we set up the Exchange Equalization Account. Those securities and currencies will lie dormant in the White international stabilization fund until the fund begins to make use of them. Once we seize hold of the fact that initially they will lie dormant, we see that the White plan and the Keynes plan are nearer together than we at first suspected.

Let me take the mechanism of the White plan. The importer's commercial bank buys in its own currency from the White stabilization fund a draft on the exporter's central bank in the exporter's currency. That draft is used to pay the exporter, who proceeds to pay it into his bank. The net result is this: in the exporter's country there is the usual increase in deposits at commercial banks and also in their cash. At the central bank there is an increase in member bank balances as before, but the offsetting item very likely will be an increase in the securities held among that central bank's assets, these new securities being those purchased from the stabilization fund by the exporter's central bank, in exchange for the draft originally purchased by the importer and used to pay the exporter.

In the same way, in the importer's banking system there will be a drop in commercial bank deposits, a drop in member bank balances at the central bank, and to gloss over some intermediate processes, a drop in the securities held by the central bank. Of course, all this is an over-simplification. The point I am leading up to is this, that under either system the net result could, if necessary and advisable, be much the same. Either system means that a medium of payment has been found which has many of the advantages of gold but not the disadvantage attaching, as in the old days of the gold standard, to wasteful and extravagant physical shipments of gold. It also has the great advantage that, unlike the gold standard, the operation of this scheme need not affect the internal banking credit position of either country. To that extent both schemes are elastic.

At the same time I am bound to say that in my opinion the White scheme has a certain rigidity, which the Keynes scheme does not possess. It is a rigidity arising out of its original principle of limited liability and commitments. For example, the White scheme recognizes that the shop may run out of stock. Hence such expedients as the rationing of scarce currencies. Hence to some extent also the encouragement in the White plan to the gold producers and others who come into possession of gold and who under the scheme may deposit their gold with the Stabilization Fund. As a further inducement they are able to get their gold back again, as and when they want it. But if the White scheme is too tight, the Keynes scheme may be too loose, and we want to find something in between.

At the same time, I say as plainly as I can that whatever modifications are made, and whatever combination is found, I hope that the Keynes idea of the



factory rather than the White idea of the shop will lie at the basis of the final scheme.

I come now to limitations. It is important to realize that both these schemes are simply schemes for the provision of an international exchange mechanism. They do not cover, though they mention, other important international objects, the restoration of the liberated areas, overseas investment, the development of backward countries, the primary produce schemes now under discussion, and so forth. At the same time, without these monetary schemes, whatever final form they take, it will be far more difficult to arrive at any workable scheme to cover all these and allied and equally important points. Unless we recognize the existence of those other questions we cannot arrive at the best possible international monetary system. They all lock and interlock together.

Finally, on the question of procedure, we must not forget that we are dealing with a large number of independent States, each with its own financial position, outlook and method of government. We must not think only in terms of the United Kingdom and the United States. What is asked for is a universal and multilateral agreement which will bind Governments to take action in certain circumstances, and to refrain from taking action in certain other circumstances. Whatever scheme we evolve, we have to recognize that in a democratic country it is difficult for any Government to bind either its successors or its own Parliament.

Therefore I suggest that we begin by fostering the general realization that some plan of this kind is needed as the only alternative to the chaos we reached in the inter-war period. We have to fit this monetary plan in with all the other cogs of the post-war machine. I am not keen on the term "expert discussion" because I never quite know what an expert is, or what an expert discussion is. I do say that an expert is the last person who can or ought to bind his Government or try to bind his Parliament. But notwithstanding all these qualifications, much of this preparatory work is best done on the expert level, both officially and unofficially. Is it too great a presumption to suggest that this Society can begin some of that preparatory work here and now?

MR. R. G. GLENDAY: The first question I asked myself when the two White Papers were published was: Why has the mechanism of currency and exchange been given priority in discussions on post-war reconstruction problems between the United Nations? Obviously there are far more important problems. Besides, it is impossible to dissociate currency problems from the broader economic issues. The currency proposals deal with symptoms; they do not deal with the causes of pre-war instability. The obvious course, if there is a real desire to arrive at a practical solution, is to deal first with the commercial problem—the exchange of goods. I assume that the reason why the cart is being put before the horse is that the political situation in the U.S.A. makes it impracticable to deal with commercial issues at the present time; so the White Papers are in the nature of a red herring.

The second question that presented itself to me was: Why are there *two* White Papers, one fathered by the British Treasury and another fathered by the American Treasury? Here, again, the answer seems to be that there is a fundamental difference of view—or approach—on even this question. To attempt to disguise or minimize this, as is being generally done on this side for purely political ends, seems unlikely to serve any useful purpose in the long run. One important matter of controversy appears to be the part that gold is destined to play in the currency and exchange arrangements of the future. The British

White Paper seems to adopt a somewhat disingenuous attitude, and it is not easy for anyone familiar with the writings of Lord Keynes to accept the references to gold at their face value. This is not to deny that the gold situation in the United States, the U.S.S.R., and South Africa introduces a complication which must be removed if the real foreign exchange problem is to be tackled adequately from the commercial aspect.

What is the real issue that lies behind these two White Papers? I suggest that it has nothing to do directly with currency at all, but with the chaotic commercial situation in the inter-war period to which Mr. Crump has referred. Before we can hope to tackle the currency problem with any hope of success, we must make up our minds as to the real causes of the international collapse in the 'thirties. No one has yet given a really clear, convincing—and generally acceptable—explanation of that collapse. Much has been written about the breakdown of the European exchanges, but it is vital to remember that the centre of the earthquake that convulsed the world trade and exchanges at the close of the nineteen-twenties lay in the United States. After a decade of continuously rising economic prosperity, the economic system of the United States was overtaken, in the autumn of 1929, by a disaster the like of which had not happened since the modern industrial systems first came into being. Not even Lord Keynes himself anticipated that anything was wrong before the cataclysm occurred. It could not conceivably be attributed to political insecurity or to any events in Europe.

I suggest, therefore, that before time is wasted in elaborating currency and exchange mechanisms *in vacuo*, it might be as well to enquire whether or not there was not some deep-seated disease responsible for the World's pre-war difficulties. Until this point is cleared up, it is impossible to determine whether the remedies proposed would make the disease worse or better.

As to the two plans themselves, I suggest that both tacitly assume that the world understands the cause of that pre-war malady and is agreed on the remedy appropriate for it. The American approach is an elaboration of the tentative tripartite exchange arrangement that was brought into operation in September 1938. In my judgment, that arrangement was in operation for too short a time to offer any firm guidance for the future. Besides, its duration was limited to a period when the curve of prosperity was rising—largely under the influence of preparations for war. There was accordingly no reason to anticipate any disturbance of the exchange situation, even without it, during those years.

The British plan has been described as an attempt to provide the pre-war Nazi German clearing system with a multilateral cloak. Despite all the unkind things that have been said about that pre-war German system, it is important to remember that not only did it work, but on the whole all the parties concerned with it benefited. In short, it was *constructive* under the world conditions then ruling. The fact that, if need be, a variant of the pre-war German system can be worked under the Keynes plan is a great point in its favour. The worst feature about the American plan is the implication that the correct remedy for the world economic problem of to-day is to return as nearly as is practicable to a system of 19th century international Free Trade, based on a gold standard: the whole emphasis being on the necessity of aiming as far as possible at restoring fixed exchange rates.

The open recognition, under the British plan, that exchange control and adjustability of exchange rates must be an accepted part of any post-war exchange machinery is its most hopeful feature. But it is a pity that American opinion has been deliberately antagonised by the suggestion that creditor countries must accept a share of responsibility for the default of debtor countries. This may be excellent as a piece of theoretical economic reasoning, but inept as a practical political proposal. And it is on the reaction of American opinion that the fate of these two plans depends.

I hope that nothing I have said will be interpreted as pessimism. I see no

cause for alarm, even if the projected international discussions on the two plans lead to no immediate practical results. It is evident that, unless the British representatives entirely lose their heads and give way to the American demands on all points, we shall be faced at the conclusion of the war with a period of anything from, at least, three to five years of foreign exchange control, during which it should be possible to treat the world situation as a practical business problem. In the process we should be able to feel our way towards building up a satisfactory system of international exchanges, conforming to the needs of a real world, instead of to some purely theoretical wishful thinking as to how the business world *ought* to behave.

MR. KALECKI said that in the general approach to these two plans it seemed to be anticipated that some compromise should be found. The logic of this seemed to him hardly justifiable. If somebody planned for a future 10 per cent. of unemployment, and somebody else for 20 per cent. unemployment, it did not follow that the correct solution was to plan for 15 per cent.; it might, indeed, be more correct to plan for 5 per cent. In an attempt to find common features in the two plans their functioning has been alleged to be fundamentally different from that of the gold standard in its influence upon the internal credit position. However, the loss of gold under the gold standard as it functioned during recent years did not necessarily involve internal credit contraction. It was true that both plans made it possible to start international transactions and provided the member countries with certain reserves, but this similarity was a relative one. The facilities were ten times smaller in the American plan and thus it might be said that here they had a case where quantity merged into quality. If the American plan was rigidly operated it would not be put out of action within half a year. Both plans started from the assumption that the equilibrium of balance of payment on current account was something which was essential. But although this might be a working hypothesis it was an absolutely arbitrary one. An international clearing might work as well on the basis of unlimited debit and credit balances. He agreed, however, that such a system might lend itself to abuse because the actual process of control to prevent some country from deliberately over-valuing its currency to "exploit" other members might be difficult. The problem might be solved by taking over credit balances over a certain level by the International Investment Board. The countries which would be granted the loans by this Board would be enabled to accumulate debit balances which otherwise would have a definite limit. The transfer of amortisation of and interest on these loans would be effected through the International Clearing. Of course, it was always possible that some countries would not like to have their surpluses taken over by the International Investment Board. Those countries would either have to import more so as not to have the surplus taken from them, or to ration their exports as was anticipated in the American plan. But this measure, which would be very unpopular with the American exporters, should not be facilitated by making responsible for it an international body instead of the United States Government. For, he thought, it was desirable that the United States should rather increase their imports or grant long-term loans than reduce their exports.

SIR ALAN ANDERSON said that the discussion about the mechanism of exchange took him out of his depth. One could be a reasonably competent driver of a motor-car and yet be unable to discuss intelligently the design of its works. He was reminded, as he listened to Mr. Crump's informative address, of conversations between two of the greatest central bankers, to which he had listened eighteen years ago, about the return of Great Britain to the gold standard. These two bankers had had no doubt what the world needed and their whole discussion, as he remembered it, centred around the technique of how to do it, but while their technical judgment was probably the best in the world the event falsified their hopes. Mr. Crump's remarks were directed in

the same way to the technical mechanism of exchange, which is as important to finance and commerce as a flywheel to an engine. So far as Sir Alan was able to judge, either of the plans might prove excellent flywheels. He was shy of the White plan because it seemed to rely more than the other plan on gold, when it was known that we had not gold; he inclined to the Keynes plan because it underlined the responsibilities of the creditor or surplus nation. But, apart from that, if they got the other things properly arranged, without which no stable exchange was possible, there must be a hundred and one ways of arranging this mechanism and probably either of these plans would work. In his view a much more important part in these plans than the detail of mechanism was the impression they gave about fundamentals. That was chiefly why he liked the Keynes plan.

Mr. Glenday had suggested that they ought to look back on the past and see what had tripped them up. The impression he had derived from a number of discussions about this at the International Chamber of Commerce was that each nation must recognize an obligation to look after its own exchange. If a nation was becoming too plus in the exchange it might make things impossible for all the other nations who were minus. What went wrong after 1925 was that the natural safety valve was taken away when Great Britain ceased to be the richest nation in the world and when the world's greatest creditor declined to be a free buyer. In the period between the two wars he did not think that any form of mechanism would have put the thing right. What was wrong was that the goods were not allowed to pass from one country to another. If it was possible to get each country which had great claims on the world to realize that it must accept payment of those claims in goods and services be believed exchange arrangements between all countries might be made with the minimum of mechanism.

MR. E. F. SCHUMACHER said that in this attempt to discover similarity or dissimilarity attention might be drawn to one very strange dissimilarity, namely, that the American plan would probably lead to exactly the thing against which the State Department and the American business community had taken a very strong stand in the past. It would lead straight into the mire of bilateralism, multiple currency devices, and so on; whereas the British plan would guard against multilateralism and make for unity in the exchange system. The initial reserves with which the different countries in the world were to be started under these two plans were not easily comparable, but under the American plan they would be only a fraction of those provided under the British scheme. Consequently the White plan had to envisage the rationing of foreign exchange by the Fund, which was a very complicated affair.

Suppose, for example, that Great Britain applied for dollars, and was informed that she could have only half of the amount for which she had applied. In that case Britain would have to introduce a system of exchange rationing at home and to tell the people concerned that if they wanted cotton they must buy it not from America but, say, from Egypt. The British exchange control would have to tell certain people who were in debt to America that there was no foreign exchange available and that they should pay their debt into a "blocked account." In a word, there would come about all the things which appeared before the war and which nobody liked. The American plan, by suggesting the method of rationing, would produce precisely the conditions for the prevention of which we needed an international plan at all.

A second point was a more fundamental one and raised a very big question. It had been stressed in that debate that there were some more fundamental factors which were really of greater significance than the exchange mechanism. These fundamental factors, in the shortest formula, were the level of effective demand—that is to say, the level of economic activity to be maintained in the various countries. The Keynes proposals stated that if a high level of purchasing power and employment could be maintained in the main centres of world

trade then the problems of unwanted export surpluses would largely disappear. The question we should ask ourselves was: "What will the two schemes do to enable or prevent nations from creating a sufficiency of effective demand within their borders?" He thought the Keynes plan deserved a very warm commendation because it left nations substantially free to solve their own internal economic problems in any way they saw fit. It did not wander from the international "terrain." No country would be forced to "march in step" with the rest of the world when the rest of the world were marching into depression. Consider what would happen in such a situation: Suppose most of the major countries suffered a slump, but one country decided to maintain home employment and its own National Income by means of an expansionist home policy. This would immediately react upon its international balance, since its own import demand would be maintained while its ability to export might decline. Under the Keynes plan such a country could sustain an import surplus for a considerable period of time (and pay for it in *bancor*) and its maintained imports would help other countries to get out of their depression. If its *bancor* quota became unduly exhausted, the country in question would be free to control its foreign trade balance by direct means—exchange control, quotas, export subsidies, and the like. In no case would it be compelled to descend into depression merely for the purpose of "keeping in step" with the rest of the world. It is doubtful whether the American plan would give similar freedom for expansion. The initial reserves it provided were much smaller, and the freedom of action of a country that had exhausted its reserves would be restricted in many directions. There were some ominous features in the American plan which were only too reminiscent of the old gold standard.

The Keynes plan contained some suggestions that the Clearing Union might be developed into an instrument for international trade cycle control. It could increase or decrease the "quantum" of *bancor*. No great reliance should be placed on this feature. International purchasing power did not in itself constitute effective demand. The latter must arise out of the various national units. All the more necessary it would seem to be, therefore, to leave the various national units free to control effective demand at home, and not to impair their ability and capacity of pursuing, if they so chose, vigorous expansionist policies within their own borders.

MR. IAN BOWEN said that one of the plans before them was British in origin and the other was American; it was therefore inevitable that it should be assumed that they represented in some degree the interests of the respective countries. It would certainly be incorrect to assert that national interest might not be detected behind some of the proposals in each plan—or, if not interests, at least considerations of national prestige which were often, unfortunately, taken to be the same thing. Because so far-reaching an economic proposal as the setting up of a clearing union involved a suitable political framework, the discussion had drifted, despite the absence of any desire to encourage political discussion, towards a frequent reference to the political as well as the economic aspect of these questions. This was shown in the debate in the House of Commons, which touched very often on the relative positions of Great Britain and America in the post-war world. This was a pity because, however inevitable it might be, the political forum was not suitable to clear economic thinking.

He asked them to consider for a moment national interests not from the political but from the economic angle. All the countries in the world had an interest in the promotion of international trade, and the post-war problems fell entirely into two periods: (1) the problem of the clearing up of the disequilibria which would be left by the war-time borrowing and lending and kindred questions of the immediate post-war reconstruction period, and (2) the longer-term issue of providing for the free flow of goods and services and for the clear definition of the mutual responsibilities of creditor and debtor nations. In regard to the second of these, the principal economic problem for all nations alike—for

America as well as for Britain—was the avoidance of world economic depressions. All other economic considerations were subordinate to this overruling and pressing interest. If the White plan were regarded as providing some solution for the problems relating to the period immediately after the war, and the Keynes plan some solution for the long-term problems, they might begin to see a way to some degree of compromise without sacrificing anything as in the analogy which Mr. Kalecki used of the choice between 10 and 20 per cent. of unemployment.

Throughout the House of Commons debate recently there was a tone of healthy recognition of the fact that after this war London would no longer be the necessary or natural financial centre of the world, but if they recognized that, in a sense, the economic well-being of the world was to lie in the scales of American justice that should not be their cue to abdicate all responsibility for what took place. In the first place, they should ask themselves in what precisely consisted the true American economic interest. If they attempted to put the world again on the "cross of gold," the economic *débâcle* that would follow would involve America's great and expanding world interests as surely as it involved those of everyone else.

On this point the suggestions of the White plan for dealing with surpluses more leniently than with deficits had justly been criticized by *The Economist* when it drew attention to the fact that the only provision was that the Stabilization Board should give immediate and careful attention to any Government with a surplus. But the problem, as *The Economist* pointed out, was that the authors of the scheme themselves seemed to doubt whether "immediate and careful attention" would be a sufficient guarantee of action. On this point Mr. Crump had said that anything which resulted from surpluses might be offset by the action of the central bank. So it might, and it might have been offset in 1931 by the joint action of the central banks. They had had some experience of the possibilities of central banks acting together, and they wanted something better than that after this war. The deficit countries were not allowed by the American scheme either to impose exchange control or to devalue their currencies; they would indeed be caught on the horns of an impossible dilemma and a crisis must ensue. As a long-term scheme the American proposals on this point were not acceptable. They would perhaps increase the stock of gold which flowed to America from all parts of the world, but he could not see how American citizens as a whole would reap any benefit.

MR. J. F. L. BRAY said that it had always been assumed that America would have a strong currency after the war, but that was not at all clear to him. Actually he thought that what would happen, according to his investigations, was that the price level in America might, and very probably would, rise very substantially before the war was over. The American budget was in very serious deficit. Between 1932 and 1942 taxes went up more than tenfold, from two thousand millions to twenty-three thousand millions, and in 1943-44 they stood at thirty-three thousand million dollars. But even so, they would not be anything like sufficient to cover more than a small proportion of the revenue required. It could be imagined that the rise in the volume of taxes from two thousand million to thirty-three thousand million was difficult enough by itself, but that thirty-three thousand millions of revenue had to go against 109 thousand millions of expenditure.

To his mind it was almost inconceivable that there should not be a very substantial addition to the volume of currency and credit in the United States in the next couple of years as a result of that situation. If that occurred, as he thought it would, all President Roosevelt's price-stops would be of no avail at all. He might dam the flood for a while, but eventually the price level was bound to go up.

With that situation went the other situation, that the price of gold was not going to be changed. President Roosevelt tried to get his power to increase

the price of gold continued, but Congress would not allow it. That happened a few days ago. Here was a situation in which the price level in America was very high and the price of gold was unchanged. The reason why that had happened was chiefly because America had "cornered" the gold. In those circumstances, if the price level of this country could be maintained more or less as it was at present, the strong currency would be not dollars but sterling. The dollar would be the weak currency. One could imagine that that would have a very considerable effect.

One other point. The calling in of gold in 1914 was, in his humble opinion, the real cause of all their troubles in the inter-war years. It was the depreciation of American currency in terms of gold in the four years 1916-20 which caused the enormous inflation and the subsequent deflation, which, to his mind, was in turn one of the chief causes of the present war. Now the same situation was occurring again. In June last the Federal Reserve Board ratio of gold was 90 per cent. By balancing the budget deficit with credit creations it was possible to reduce that ratio step by step, and the only legal limit was 40 per cent., which meant that the volume of credit and currency could be doubled and the price level in America could be doubled, and then one reached the point where the dollar was seriously undervalued in terms of gold. In that situation it was necessary either to deflate so that the gold producers could again earn a living, or else to write up the value of gold in terms of dollars, or to enter into the wilderness of paper currencies everywhere. That was the dilemma which would present itself in a couple of years or so, he was persuaded. He wished the meeting to consider where these three possibilities were likely to lead. The first possibility was already met with last time, when everybody deflated; the second possibility would just lead to renewal of the old "hurdy-gurdy," and the third possibility would be absolute chaos.

MR. T. W. WYATT said that neither the Keynes plan nor the American plan nor any other kind of financial device could possibly work unless the countries with the strong currencies were prepared to buy from the countries with the weak currencies. Until that very important point was faced they were wasting their time. Both the plans were putting the cart before the horse. He did not wish to pillory the United States in this matter; we were as bad in this country in this respect. We made a very serious mistake in the inter-war period. It would be remembered that we were supposed to have had an adverse balance of trade, and in consequence of that we restricted foreign lending and reduced our imports. We reduced our imports mainly from the very countries which had weak currencies as compared with our own. It was quite clear that when a country had a depreciated currency in relation to our own we were in respect to that country a surplus country. Thus it was possible to be both a surplus and a deficit country. If the surplus country did not wish to import goods from the countries with weak currencies it must be prepared, if it wished to continue to export, to lease-lend its goods to other countries which needed them. That would be of enormous assistance to the surplus countries, as it would stabilize their export trade. There was no doubt that the aim of full employment for every country was absolutely necessary, and until we had put our own house in order we would have little right to speak to others. What was the reason why we could not find full employment in our own country?

Provided, and only provided, we remembered that a country with a strong currency must be prepared to buy from the countries with a weak currency, or else must be prepared to lease-lend to other countries, the Keynes plan would be a very useful method of assisting international trade; otherwise such discussions as the present were a waste of time.

MR. GAMPELL said that it was a matter for pride that the author of the Keynes Plan, like that of the Beveridge Plan, was not only their fellow-countryman but a Fellow of their Society. But that pride in what was essentially a

cultural value ought not to be confused with power politics. Britain's only selfish interest in this matter was a selfish interest in peace and prosperity for the whole world. Regarding the spurious controversy over voting rights, he personally would prefer the United States, or for that matter Paraguay, to have 100 per cent. voting power under the Keynes Plan than Britain to have 100 per cent. under any less enlightened plan, simply because the one meant prosperity and peace, while the other threatened depressions and wars.

Of the two, he would rather prefer Paraguay. Entrusting such a matter to one of the smaller countries would have many advantages. On the one side it would vindicate the sincerity of the United Nations' various professions about "great and small nations alike." On the other side it would be eloquent of a fundamental feature of the Keynes Plan, namely the subservience and relative unimportance of money. What Lord Keynes had done was to extend to the international field the great internal banking discovery of recent years, namely that whatever was physically possible must be financially possible, that it was open to governments to create all the money necessary to bring productive resources into full use. But the resources and the use were more important than the money. Internationally there was need of a similar demonstration that the important thing in international economics was not foreign exchange, but foreign trade; that money was only a facility. It was or ought to be as great nonsense to talk about an international money power as about an international postal power. In administering such international facilities small nations like Holland and Switzerland had often been given exceptional responsibility and had lived up to it. Voting rights were in any case of the less importance since, if it ever got to the stage of questions having to be decided by voting it would mean that the scheme had broken down; and if it ever got to the further stage of votes being decided by power politics, it would be only a matter of time before they had another war.

The opener of the debate in the House of Lords that afternoon, like one of the earlier speakers in the Society's discussion, had referred to criticisms that the plan put the cart of foreign exchange before the horse of foreign trade, but after Lord Keynes himself had followed with a masterly speech no one in the assembly could have felt that this was a valid criticism.

Mr. Gampell could not agree with the opener that there was any material difference in whether the international money was created by the various governments individually or collectively. As Lord Keynes had put it, the so-called "security" against the overdrafts in the American plan would, except for its small gold fraction, consist only of a better-quality notepaper on which the IOU's would be printed, but the money in either case would be IOU's of the governments. The important thing was that there should be a real international money, with its volume determined (in accordance with the needs of international trade) in the same way as was the volume of internal bank money, namely by the aggregate overdrafts which the banking system, with such prudence as Providence might have given to its executives, decided to create in accordance with defined rules and after studying, with such acumen as it might possess, all such relevant data as it could get. In other words, it should be regulated by reasonable men applying reasonable rules. Nobody could say that the gold standard automatically did that.

He had not thought it a defect of the Keynes Plan that it proposed more definite sanctions on excessive debtors than on excessive creditors, because the Clearing Union, after all, was not an ordinary bank. Its members were potential borrowers and sovereign states. In a pub where the customers were also the owners it appeared no bad thing that the bias, if any, should be towards temperance. Lord Keynes that afternoon, however, had indicated that he would have preferred to put more onus on creditors, had it been expedient.

Three prevalent misconceptions about the Keynes Plan were that it envisaged the United States as a surplus country, that it was less favourable to gold than was the American plan, and that it might prejudice cheap money. The truth



appeared to be the exact opposite in each case, above all in regard to cheap money. What had most impressed him in listening to Lord Keynes was that the one element of sovereignty which Lord Keynes would never surrender was Britain's sovereign right to cheap money. A key thread of the Plan was control of capital transfers for the sake of cheap money for the sake of full employment. Lord Keynes appeared to regard these as both necessary and, to a large extent, sufficient to that objective. There was no apparent conflict between the Keynes and Morgenthau plans on this point. The Keynes Plan looked on control of current trade remittances as positively noxious, while the American plan made a specific reservation in favour of control of capital transfers. It had been a relief to hear Lord Keynes assert that this control would not require the perpetuation of postal censorship, and he hoped the Minister of Information had taken due note. Previously he had not seen how capital transfers could be controlled in the absence of postal censorship or how postal censorship in peace-time could be reconciled with democracy. The implied explanation was that the Americans must have agreed to some registration and interchange of banking information.

Lord Keynes, in his opinion, intended this policy not as economic nationalism but as the very reverse, namely as our contribution to international prosperity. The one mention of it in his White Paper, and then only oblique, was in the paragraph which affirmed his optimistic faith and denied the inevitability of unbalanced trade positions "If active employment and ample purchasing power can be sustained in the main centres of world trade, the problem of surpluses and unwanted exports will largely disappear." That had been widely regarded as an aside; it might be truer to regard all the rest of the Plan as an aside.

Finally, he could not understand why Mr. Crump had taken it for granted that the United States would be a surplus country. Given the huge mass of hot money in the United States, the rapid inflation of American costs and prices, and the extreme indiscipline of the American economy, there was evidence on all hands that the dollar was the most rapidly softening of currencies. As soon as the two plans were published, one of the comments which, as a journalist, he had sent all over the world was that the United States was almost bound to be the first country to reach its overdraft limit. Lord Keynes had demonstrated that when the Americans took it for granted that the United States would be the chronic surplus country, they were implicitly taking it for granted that the United States would have chronic slump. The plan was in truth more necessary to the United States than to Britain.

MR. CRUMP, in reply, said that the discussion had been most useful, and he did not think that there was much which he could add. Mr. Glenday had asked why a currency scheme had been given priority. The easy answer was that a beginning had to be made somewhere, but a better answer was that a start could not be made with the solution of the deeper world economic problems until the world's money system had been placed on a sound and practicable basis. Otherwise everyone would be building on sand. To give one problem priority did not mean that other problems would be neglected.

In this connection Mr. Bowen had made the interesting suggestion that the White Plan was in effect a short-term plan, while the Keynes Plan was a long-term plan. This view was valuable, because it emphasized the dual nature of the post-war monetary problem—namely, (a) the accumulation during the war of international short-term debts; and (b) the need for ensuring the free flow of goods between debtor and creditor nations. In Mr. Crump's view, the essence of both plans was to give nations an initial reserve of international money, so that in this way they would get a flying start after the war. Sir Alan Anderson's analogy of the flywheel was very apt.

Two important points had emerged from the discussion. The first was that in the long run creditor nations must be prepared to have an import surplus. Unless this was faced, neither the Keynes nor the White Plan could be more than a palliative.

The other point, voiced by Mr. Bray and Mr. Gampell, was the future position of the United States. There were indications of the development of a paradoxical situation. On the one hand, the United States would be a creditor nation, with an enormous gold reserve and also an active balance of payments. On the other hand, the United States was finding it difficult to maintain a stable internal economic régime, and it seemed likely that she would emerge from the war with her level of prices, wages and costs well above our own level, as measured by an exchange rate of \$4.03 to the pound.

Such a position resembled those problems popular with mathematical examiners, who, after enunciating a very tangled set of data, end up with the blunt request "discuss the subsequent motion." I have no intention of doing so to-day. Suffice it to say that it will be a position of great economic stability, and I agree with those speakers who said that the flywheel provided by the White Plan, and still more by the Keynes Plan, may very likely stand the United States in good stead.

As a result of the ballot taken during the meeting the candidates named below were elected Fellows of the Society:

Benjamin Arthur James Bone, F.I.A.  
Owen Stanley, Viscount Buckmaster.  
Lt.-Col. Hugh D. Butler.  
William Alfred Carne.  
Gordon Hanby.  
Edmund Constantine Innerarity.  
Reginald Campbell Morrison.

Arthur Charles Pallot, M.B.E., B.Sc.,  
M.Inst., C.E.  
Wilfred Bernard Pyett, C.A.  
Arthur Robert Victor Steele.  
David Halton Thompson, M.A.  
Bertram Alexander White, B.Sc. (Econ.).

*Corporate Representative.*

O. Gross, *representing* The Economic Research Group, c/o Unilever House, Blackfriars, E.C.4.

## METHODS OF ESTIMATING THE BURDEN OF TAXATION

By G. FINDLAY SHIRRAS, M.A.

[Read before the ROYAL STATISTICAL SOCIETY, June 22nd, 1943,  
the President, Mr. H. LEAK, C.B.E., in the Chair.]

THE object which I have this afternoon in addressing the Royal Statistical Society on the methods of estimating the Burden of Taxation is to have a discussion by Fellows on the methods of an Enquiry undertaken in University College, Exeter, at the request of the National Institute of Economic and Social Research, an Enquiry which in simple terms was to estimate how much was paid in taxation out of each of a number of different incomes in the pre-armament year 1937-38 and in a recent war year 1941-42. The Report of this Enquiry has already been published in this country and also recently in the United States. The pioneer estimate of the burden of taxation is that contained in the classic Presidential address of Sir Herbert (now Lord) Samuel to the Royal Statistical Society in 1919, and in 1927, it will be remembered, the Committee on National Debt and Taxation, known as the Colwyn Committee, published its Report with statistics up to the year 1925-26. There has been a revolution in British taxation in recent years—a typically British revolution, in that it had respect for tradition, but the burden of taxation now is so heavy that it was considered most desirable to attempt its measurement. It goes without saying that the war has completely transformed the scale of taxation, and, as is not unnatural in wartime, a greater slice than ever before of the net national income is now taken. In 1942 taxation was of the order of 30 per cent. of the national income, as compared with something like 6 to 8 per cent. in 1913-14 and 17 to 19 per cent. in 1925-26. My colleague, Dr. L. Rostas, and myself were fortunate in having the co-operation not only of a Special Committee of the National Institute, consisting of Mr. Geoffrey Crowther as Chairman, Mr. Henry Clay, Professor R. R. Hicks and Mr. Nicholas Kaldor as Members, but we also had the greatest assistance from various Government Departments, notably the Treasury, the Board of Inland Revenue, the Board of Customs and Excise, the Ministry of Labour and National Service, the Ministry of Health, the Board of Trade, the General Post Office, the Ministry of War Transport, the Petroleum Department, the Ministry of Food and other Departments, as well as the Chambers of Commerce and unofficial persons of all classes. I do not propose to deal with the results already published, but for purposes of reference these are summarized in tables appended to this paper. What we are interested in this afternoon is a "post mortem" as it were of the methods that have been followed in this piece of team research.

Economic research is the patient and methodical business of getting knowledge from hidden uniformities, and there are many important tasks which are beyond the resources of the individual investigator and which call for the co-operation of a number of investigators with different capacities and different training. Industry and scientific technique are not enough. The really important thing is that team research, as indeed individual research, is directed towards the answering of significant questions, and we can hardly frame these significant questions except in the light of definite hypotheses. Formulating questions and hypotheses was the first and most important task which we had to undertake. We have been able to present a more comprehensive picture of the burden of

taxation than has ever been done before. We have been able to allocate over four-fifths of the levies to the various incomes that bear the taxation, but the remainder which has been taken into account has not been assigned to individual incomes, for reasons that will be explained. The most important of these omissions is that dealing with the burden of local rates on various incomes, a matter which has recently been under examination by Professor and Mrs. Hicks.

One or two caveats must be mentioned at the outset, and these are: firstly, as regards the accuracy of the figures. A glance at the appendix may give the impression that the figures are precisely accurate. This is not so. The burden of income taxation is more or less accurate although in this connection there are qualifications that do not always meet the eye of the unwary, such as allowances for life insurance, claims for expenses, etc. There is a greater or less margin of error in all our calculations. As Dr. Rostas and I stated in the Report, "They are not exact figures but more or less close indications of the orders of magnitude involved." Another caveat is that the estimates do not take into consideration the advantages—which are considerable in the lower incomes—from public expenditures, and therefore before any judgment is passed on the burden—as, for example, in the lowest ranges—the fact that the citizen derives considerable advantage from what the State spends is not taken into account. Such expenditure as the amount spent on social services benefits particular classes, while expenditure on defence and administration benefits all classes alike. In other words, the value of the benefits of public expenditure has not been deducted from the figures showing the burden of the individual income. A third caveat is the definition of a tax. We have included any compulsory contribution to public funds raised from the public. In other words, a tax would include compulsory contributions to the social services and other services which people are compelled to accept, especially when the cost of the service rendered is more than covered by the fees levied by Government, as for example in the motor licence duties, which are much greater than the expenditure on the roads; Post Office net revenue—*i.e.*, the surplus that remains after paying for the cost of the running of that Department—is also of the nature of taxation. Lastly, it has been assumed in regard to the incidence of taxation that the burden is borne where it is intended to fall. Direct taxes are assumed to be borne by the payer and indirect taxes by the consumer, death duties are assumed to fall on the estate and protective customs duties on the consumer. Taxes on business profits are assumed to fall on those who own the shares or the business capital of the company, although it was not found practicable to allocate these taxes to specific incomes. Direct taxes were taken to include income tax, surtax, death duties, employees' social insurance contributions and the taxes on profits. In other words, mainly the inland revenue duties, but not entirely. Indirect taxes include the remainder—practically the whole field of customs and excise duties, the motor vehicle duties, Post Office net revenue, employers' social insurance contributions, the greater portion of stamp duties and rates. The family in the Enquiry was not the social family, but the tax-paying family, and owing to the fall in the size of families in recent years, the family of four, consisting of a man, his wife and two children below sixteen or children who have no independent incomes, is taken. It is interesting to compare this with the structure of the average working-class family as illustrated by the last Family Budget Enquiry of the Ministry of Labour relating to industrial households, where the average number of persons

per household was 3.77, as compared with the tax-paying family of four members. The Family Budget Enquiry of the Ministry of Labour was for working-class households \* for 1937-38. In the tax-paying family we have one male over eighteen and one female over eighteen and two children, and the wage-earner or salary-earner is one per household. In the average actual social family these numbers are respectively 1.22, 1.25, and young persons 1.30, the average number of salary-earners per household being 1.75.

There are other limitations to which a reference might be made in regulating the money burden, such as, for example, the fact that the tax liabilities for any particular year are assumed to be payable in that year. Statutory income is not always a measure of the actual income for the year, but in the Enquiry it was assumed that there was a common income to which indirect taxes may be referred.

With these explanations I now plunge in *medias res*. We divided taxes into seven main groups. The first category included the unavoidable taxes, including the taxation of income and taxes on what everyone consumes, such as tea and sugar. This unavoidable burden of taxation includes, in short, income tax, surtax, employees' social insurance contributions, the tea duty, the sugar duty, and a few very indirect duties on such things as matches. It also includes death duties and rates on dwelling-houses. A second group includes taxes on tobacco, alcohol, entertainments and private motoring. A third group includes the purchase tax, protective duties, duties on buses and taxis. It may be noted that to estimate the burden of the avoidable taxes, of which by far the largest are those on tobacco and alcohol, varies between different size families of the same income, because consumption depends as much on the taste of the consumer as on the number of persons in the family. It is true, perhaps, that the fathers of large families smoke and drink less than single men, but it is impossible to estimate, or even to guess how much less. In another category is the taxation following on production in general. In another there are taxes on business profits. War-damage contributions and war-risk premiums form the sixth category, and a miscellaneous set of items, including other inland revenue, other customs and excise revenue, part of stamps, local dues, tolls, etc., have been grouped in the last item. These have been shown in our Report and are briefly as appear on p. 217.

It is easier to calculate the burden of a tax on an article which everyone consumes, such as tea and sugar, than it is to estimate the burden on alcohol or tobacco, for reasons already given. It is also difficult to assess the burden of such taxes as the purchase tax, protective duties, taxes on public motor transport (which are passed on in the fares charged), taxes on business profits, Post Office net receipts and local rates.

It is now necessary to pass in review the methods which were followed in the calculation of the various taxes, in order that Fellows of the Society may criticize what has been done. When this Enquiry is again brought up-to-date no doubt these suggestions will receive the most careful consideration.

#### *Income Taxation*

Firstly, as regards income tax: this is probably the simplest of all taxes to assign to the various incomes, although here one has sometimes to walk with

\* 8,905 industrial; 1,491 agricultural, 366 rural.

great care and note the assumptions. For example, the taxpayer's actual income and his statutory income (*i.e.*, his income as defined by the Income Tax Acts) were assumed to have been the same, which is not in strict accordance with fact, since many taxpayers deduct a certain amount of expenses from 'actual' income in order to arrive at statutory income. The error, however, is probably quite small. It is the income-tax statistics which show the revolutionary changes

TABLE I  
*The Distribution of the Tax Burden according to Tax Categories.*  
(United Kingdom)

	1937-38	1941-42
	£ mill.	£ mill.
I. Direct personal taxes and commodity taxes on essentials (unavoidable taxes) . . . . .	610.0	1,052.0
Income tax and surtax <sup>1</sup> . . . . .	299.0	695.0
Commodity taxes on essentials (tea, sugar, wheat, coal, postal services, etc.) <sup>2</sup> . . . . .	36.0	59.0
Rates on dwelling-houses . . . . .	133.0	146.0
Employees' social insurance contributions . . . . .	52.0	60.0
Death duties <sup>3</sup> . . . . .	90.0	92.0
II. Taxes on non-essential goods and services . . . . .	241.0	478.0
Alcohol and tobacco . . . . .	198.0	442.0
Entertainments . . . . .	8.0	16.0
Private motoring <sup>4</sup> . . . . .	35.0	20.0
III. Purchase tax and protective duties, duties on buses and taxis . . . . .	66.0	132.0
IV. Taxes on production in general <sup>5</sup> . . . . .	175.0	212.0
V. Taxes on business profits <sup>6</sup> . . . . .	66.0	425.0
VI. War damage contributions and war risk insurance premiums . . . . .	—	303.0
VII. Other items <sup>7</sup> . . . . .	18.0	15.0
	1,766.0	2,617.0

<sup>1</sup> Tax on undistributed profits deducted and added to V.

<sup>2</sup> Including duties on tea, sugar, coffee, cocoa, household matches, patent medicines, table waters, wheat, coal and postal services.

<sup>3</sup> Estate duties in Northern Ireland included.

<sup>4</sup> Vide Chapter XII.

<sup>5</sup> Vide Chapter XVI.

<sup>6</sup> Vide Chapter VII.

<sup>7</sup> Including other Inland Revenue, other Customs and Excise revenue, part of stamps, local dues, tolls etc., social insurance contributions in Northern Ireland and unemployment contributions to the agricultural and special schemes.

in taxation between the pre-rearmament year 1937-38 and the war year 1941-42 as progression has been stepped up tremendously since the war. This is seen in the Tables quoted from page 74 of the Report (Tables 9 and 10), and in Appendix I of this paper.

The real problem in the estimation of the burden of direct taxation lies with death duties, which are, of course, assessed on capital and payable at irregular intervals. There is no reason why, although paid at sometimes long intervals on capital, they should not be considered as taxes that weigh on income. They are

deferred taxes, and are always taken into account by a reasonable man in assessing the weight of taxation which he has to bear. It is, as it were, a backward-looking tax payable on the estate left by the decedent. Previous Enquiries, including that of the Colwyn Committee, estimated the burden of these duties simply by stating the cost of taking out a life-insurance policy sufficient to cover the duties and leave the capital intact. When we came to apply this method to the present rates of taxation it gave figures greatly in excess of 100 per cent. for the largest incomes. To state that in the payment of taxes a rich man pays more than 100 per cent. of his income is, as has often been pointed out, to imply that

TABLE II  
*Effective Rate of Income Tax and Surtax for the two Limiting Categories*

Income	Single person Fully investment income		Family of five Fully earned income	
	1937-38		1911-12	
	s. d.	s. d.	s. d.	s. d.
100 ... ..	—	—	—	—
150 ... ..	6½	3 0½	—	—
200 ... ..	10	3 11	—	—
250 ... ..	1 2½	4 6	—	—
300 ... ..	1 10	5 5	—	—
350 ... ..	2 3½	6 1	—	5½
500 ... ..	3 1	7 3	1½	2 1
1,000 ... ..	4 0½	8 7½	1 9	5 6½
2,000 ... ..	4 6½	9 3½	3 1½	7 6
2,500 ... ..	4 10	9 10	3 9	8 5
5,000 ... ..	6 2	11 8	5 7	10 11
10,000 ... ..	7 11	13 10½	7 8	13 6
20,000 ... ..	9 8	16 3	9 6	16 1
50,000 ... ..	11 4	18 2½	11 4	18 1½
150,000 ... ..	12 7	19 1	12 7	19 0½

he or his heirs would be better off if he had less property. That is absurd. We therefore searched for another method of estimating the burden of death duties, and adopted one advised by Mr. Nicholas Kaldor, whose Memorandum is printed in the Report and as Appendix III to this paper. The burden of death duties on a given property income depends, as Mr. Kaldor shows, not only on the value of the property *now*, but also on how much of the income from it is saved between the present and the time of death of the owner of the estate. The problem is to make a reasonable assumption about the volume of saving by those liable to death duties, and no one assumption is really valid. The insurance method assumes that everyone saves enough, but only just enough, to keep his capital intact or, in other words, that a rich man is presumed to be willing to draw on his capital in order to keep his capital intact. Under the method adopted in the Report two assumptions are made. The first is that there is no net saving at all, which gives a minimum estimate of the burden of death duties, and the second is that saving is done to exactly such an extent as will, over time, provide the maximum income from the property. A reviewer has somewhat severely criticized this method. Speaking of our method, he says: "The old method, adopted by the Colwyn Committee, was to take the annual

premiums required for an insurance policy sufficient to cover the death duties. This may exaggerate the burden as the putative insurance policy increases the duty to which the estate is liable. It would be quite proper to accept our authors' assumption that the duty occurs every thirty-one years, their estimated length of a generation. On this basis the simplest plan would be to divide the rate of death duty by thirty-one and take the quotient as the annual rate of tax. It would then rightly appear that the rich have to pay considerably more than 20s. in the Pound altogether. This means that in the long run they have to deplete their capital to pay taxes, and, in addition, finance all their own expenditure out of capital." He adds that we "compare the 'present value' of a man's whole stream of future income, after deduction of income tax and surtax but without deduction of Death Duties, with the 'present value' of his future income reduced by Death Duties. They take the difference between the interest on these two 'present values' to measure the burden of the Death Duties. This method makes the burden appear less by bringing in as a set-off the saving of income tax and surtax due to the progressive diminution of the estate. Common sense will not accept this mode of reckoning. What Dr. Kaldor in effect says is: 'Think of all a man is saved in taxation by being poor; therefore the Death Duties, by reducing him to poverty, save him all this money; therefore they are not so onerous as appears'! Our authors claim that this method is 'scientific' (p. 79); but it is really fallacious in principle. The fallacy resides in the method of assessing 'the present values' of future incomes. If interest is at 4 per cent. we usually say that the 'present value' of £100 available in fifty years' time is about £14 3s. This is because a man by sacrificing £14 3s. now and letting it accumulate at compound interest can get £100 in fifty years' time, and, conversely, by surrendering a claim for £100 in fifty years' time he can get £14 3s. now. But if, owing to taxation, a man has to surrender not £14 but about £140 to get £100 in fifty years' time, the 'present value' to him of £100 in fifty years' time may be anything up to £140. We are concerned in this case with the 'present value' to the individual of his future income, and not its 'present value' to the community, since we are endeavouring to assess the burden on the individual. Consequently Dr. Kaldor's 'present value' method is inapplicable to the purpose, and is liable to under-estimate the burden of Death Duties; it would be unfortunate if it were generally adopted." \* It will be interesting to have the views of Fellows in this regard.

It will be noted that employees' social insurance contributions have been included in the calculation of the burden. The charge is a regressive one, representing in 1937-38 from 3.5 to 1.4 per cent. on incomes ranging from £100 to £250 per annum, and in 1941-42, 4.2 to 1.2 per cent. of the earnings of a tax-paying family with incomes from £100 to £350 per annum. This percentage is based on the supposition of 44 weekly contributions in 1937-38, and, because of better employment, in 1941-42 on 48 weekly contributions. The Family Budget Survey of the Ministry of Labour and National Service shows that social insurance contributions amount to 2 per cent. of the total expenditure, and probably also to 2 per cent. of the total income of an average industrial household. Recent Family Budget Surveys in Gloucester, Glasgow and Leeds also show the same proportion—about 2 per cent. in relation to average incomes.

\* *The Listener*, February 18th, 1943.



*Indirect Taxes*

To calculate the burden of indirect taxes the following facts have to be considered. Some of the commodities on which duties are levied are in general consumption. Tea, sugar and cocoa belong to this category. In these cases income is the most important factor which decides the amounts consumed. But the variations in consumption are to be found in the lower income strata. Above a certain level the amount of tea or sugar consumed is generally speaking constant. In these cases we were able to use the results of the different family budget enquiries for the working-class incomes. We were able to assume after careful enquiry that tea and sugar consumption did not vary above a certain level (£300). In the case of alcohol and tobacco consumption is optional and here income is not so important as factors such as personal taste and occupation. For this reason the burden was worked out on many potential consumption levels, light, moderate and heavy, which variations are, as it were, superimposed on the variations due to different income levels. Family budget studies, both working and middle class, were also examined but none of these was accepted unless scrutinised to see whether they were consistent with each other or with other known data as those of national consumption.

It would be impossible here to describe in detail what has been described in Chapters V to XVI of Part II of the Report. These chapters were the result of much study of the data provided by the statistics of general consumption, family budgets and also the experience of the trades concerned. These figures before publication were carefully examined by experts in Government Departments and elsewhere, and although some of the estimates are guesses, they are consistent with each other and fit the known facts. The calculation of the burden of the tea and sugar duties, for example, is easy as compared with that of the duties on tobacco and alcoholic drinks, entertainments and private motoring. The main indirect taxes—namely those on tea, sugar, tobacco, alcoholic drinks and petrol—it may be remembered, are specific and not *ad valorem* duties. Thus the burden is independent of the quality of the dutiable goods, and is entirely dependent on the quantity consumed, and, owing to the fact of Empire preferences, Empire goods are cheaper, and people in the lower-income strata are inclined to purchase them and to bear a lower tax burden. The burden of the tea and sugar duties is low on all income levels except the two lowest income levels selected, and on incomes of £100 to £150, especially where there are large families, the burden is by no means negligible. We were able by a study of recent Family Budget Surveys, such as those of Sir John Orr, Sir William Crawford and H. Broadley, the Ministry of Labour Budgets of 1937–38 and Middle-Class Family Budgets, together with the data of the National Consumption of Tea, to estimate the burden of the duties. I do not propose in discussing this portion of the Paper to go into great detail of the methods adopted, but to give a general picture of the method followed. Doubtless Fellows who are specially interested in any of the articles on which the burden has been calculated will refer to the chapters in Part II of the Report. What, as statisticians, we are chiefly concerned with, is whether the methods followed are generally correct.

Let me take as an example two of the most difficult chapters of the whole Report—the chapters on the tobacco duty and on alcoholic drinks, Chapters IX and X respectively of the Report. Here we were confronted with the fact

that not every taxpayer consumed tobacco or alcoholic drinks; the amount of income is a factor in consumption, but consumption is a matter of personal taste, with infinite variations from person to person. Our investigations in tobacco show that the number of cigarettes consumed is much the same among smokers of all incomes except the very poor. The amount spent on cigarettes varies because of the difference in the brands consumed by the lower (under £350), middle (£350 to £1000) and higher (£1000 and over) groups; since brands vary in the amount of tobacco in the cigarettes as well as in price, the aggregate burden of duties shows a closer relation to income than does the number of cigarettes smoked. Occupation, age and sex have a far greater influence than income on the consumption of tobacco. Expert investigation into the smoking habits of the people, based on a sample of about 50,000 adults, suggested that in 1938:

(1) Seven-eighths of the cigarettes (approximately 59,000 millions) were consumed by men and about one-eighth (approximately 8,000 millions) by women.

(2) Non-smokers of cigarettes in the total population were about one in ten men and about two in three women.

(3) The proportion of men who did not smoke pipe tobacco was about three in five.

From this it was concluded that, as stated in our Report, in 1938 the average consumption per cigarette smoker was 74 cigarettes per week for a man and 25 for a woman. The main range of variation from 35 to 350 cigarettes a week for a man and from 10 to 100 or more cigarettes a week for a woman. A pipe smoker, if he also smoked cigarettes, consumed in addition 2 oz. per week of tobacco, equivalent in terms of cigarettes to a further 50 or 60 cigarettes a week. A reasonable average for a man who smokes pipe tobacco only is probably 3 to 4 oz. per week. In our calculation we allowed for casual or ineffective smokers (mainly youths and women), and after consultation with the trade, we were of opinion that possibly one-sixth of the tobacco smoked by the public is that of casual or ineffective smokers. The average consumption of regular smokers including the casual smokers for the two periods 1937-38 and 1941-42 are as follows:

(1) The average consumption of male smokers consuming cigarettes only:

1937-38: 100 per week.

1941-42 \*: 120 per week.

(2) The average consumption of male smokers consuming pipe tobacco only:

1937-38:  $3\frac{1}{2}$  oz. per week.

1941-42 \*:  $4\frac{1}{2}$  oz. per week.

(3) The average consumption of male smokers consuming cigarettes and pipe tobacco:

1937-38: 70 cigarettes and 2 oz. tobacco per week.

1941-42 \*: 85 cigarettes and  $2\frac{1}{4}$ - $2\frac{1}{2}$  oz. tobacco per week.

\* Rate of consumption in July 1941 based on current withdrawals of tobacco leaf permitted by the Government. It is borne out by the provisional figures of receipts from tobacco duty for 1941-42.

Total national expenditure on tobacco (at retail prices) for the fiscal year 1937-38 has been estimated at £165-£170 millions, or over £13 per annum or 5s. per week per family, including non-smoking families. With the exclusion of the latter, the average may well have been of the order of £15 per annum or over 6s. per week.

The increase of consumption in 1941-42 is explained by the fact that not only did the regular smokers increase, but the consumption by regular smokers was maintained if not increased as compared with pre-war consumption. New consumers are recruited from the fighting forces, the civil defence services and industrial workers with increased purchasing power. Salaries and wages in 1941-42 according to the White Paper were in 1941 £1,338 millions and £2,970 millions out of a total national income at factor cost of £6,610 millions, and in 1942 £1,408 and £3,409 millions respectively out of a total of £7,384 millions. In 1938 these figures were: salaries £1,081 and wages £1,787 out of a total of £4,490. Long hours of black-out during the winter, fewer sweets and the spending of time in shelters all act as incentives to intensive smoking. As the Tobacco Controller stated, "Before the war we were smoking from 195 to 197 million lb. . . . In the present year (1941) the consumption will be from 230 to 240 million lb." or 20 to 25 per cent. above that of 1937-38.

Our estimates of the burden, which have been accepted I may say by a very large firm of tobacco manufacturers which prefers to remain anonymous, are for both years 1937-38 and 1941-42. It will be noted that average consumption figures for cigarette smokers show that on an average 450 cigarettes go to the pound of tobacco. It does not correspond to any special brand, such as the brands usually consumed—Player's Medium, Gold Flake, Capstan, Craven 'A,' or the smaller cigarettes such as Woodbine, Player's Weights, Park Drive, De Reszke Minors, etc. The difference in price is usually due to the difference in weight of the cigarette. There are far greater variations in the brands of pipe tobacco, which number many hundreds, differing in price mainly on account of the proportion of Empire tobacco used. The burden of tobacco duties on incomes with an allowance for the duty on matches has been set out in Tables 36 and 37 of our Report, which show at a glance the burden of duties. The burden of tobacco duties on incomes with an allowance for the duty on matches based on a moderate consumption of a man and wife is also given in the Report, and for facility of reference is as follows:

TABLE III  
*The Burden of Tobacco Duties on Incomes with Allowance for the Duty on Matches*

(Moderate consumption of man and wife assumed)

Income	1937-38	1941-42	Income	1937-38	1941-42
£	£ s.	£ s.	£	£ s.	£ s.
100 ... ..	3 0	7 0	350 ... ..	7 0	15 15
150 ... ..	4 0	9 5	500 ... ..	8 0	18 0
200 ... ..	5 0	11 5	1,000 ... ..	8 10	20 0
250 ... ..	5 15	13 0	2,000 and over	9 0	21 0
300 ... ..	6 10	14 10			

Next as to the duties on alcohol. Little information is available as to the expenditure by particular individuals or groups of individuals on alcoholic

drinks, or as to the variations in drinking habits as from one group to another. Family budgets are of little assistance, since these as a rule give only the consumption in the home, or what has been paid out of family expenditure. This consumption, as in the case of tobacco, is only a small part of the total consumption of the tax-paying family. The consumption either in the form of beer, spirits or wine, although not independent of income, is to a large degree a matter of personal taste and social habit. Occupation, as in the case of tobacco, is another factor. The consumption by workers in the heavy industries, such as iron, steel, shipbuilding and mining, is heavy compared with those in light industries, such as agriculture. The consumption in north-east England is heavier than in the south of England. In Scotland consumption of spirits is heavier than in England. Our estimates are intended to be representative for the country as a whole, and the results arrived at after much labour have, I think, been acknowledged to be the best possible in view of all the circumstances. They are set out in Chapter X of the Report, and, in view of the total yield of the duties on alcoholic drinks and the known national consumption in 1937-38 and the estimated consumption in 1941-42, the burden was as follows:

Income group				1937-38	1941-42
Lower	...	...	...	£4-11 (the average burden falls between £6 and £8)	£8-18 (the average burden falls between £10 and £14)
Middle	...	...	...	£7-11	£9-15
Higher	...	...	...	£13-30 (and over in the case of heavy entertaining)	£15-32 (and over in the case of heavy entertaining)

The burden of the duty based on the consumption of husband and wife with an allowance for liquor licences is a very rough illustration of the aggregate burden of the taxation on alcoholic drinks. If the burden of taxes for light and heavy drinkers is required for beer, spirit and wine separately, a reference should be made to Tables 47 and 48 in the Report. Here again criticism of the methods adopted, which were not arrived at except after very careful consultation with officials and with the trade, would be helpful.

#### *Entertainments*

The burden on account of entertainments depends upon the frequency of visits to places of entertainment and the prices paid by the different income levels. The price of seats is largely dependent upon income while the frequency of visits is altogether independent. In fact alternative sources of leisure may diminish this frequency in the higher income levels. Since 1916 the entertainments duty has been a prominent feature of the British tax system, and produces something of the order of at least £10 millions per annum. Our estimates have been made on the basis of a consideration of (1) the total receipts from the entertainments duty, (2) the rates of duty, and (3) the national and individual expenditure on entertainments. The national expenditure on entertainments in 1937 was of the order of £75 millions. Trade estimates put the total box-office receipts from cinemas at £45-£50 millions in 1937-38, and according to estimates seats up to and including 9d. accounted for one-quarter of the total receipts (in terms of attendance, more than half the tickets sold were at 9d. and under).

The approximate receipts of duty from different kinds of entertainment in 1937-38 were as follows:

	Receipts (£'000)	Percentage of total receipts
Cinemas ... ..	5,400	67·7
Football, cricket, racing ... ..	990	12·4
Theatres and music-halls ... ..	1,060	13·3
Others ... ..	530	6·6
Total ... ..	7,980	100·0

It was found that the average working-class expenditure for industrial households in the recent Family Budget Survey of the Ministry of Labour was *rs. 4½d.* per week, out of which *10½d.* was spent on cinemas, *2½d.* on football matches, etc., and *3d.* on music-halls, theatres and dances. This yearly expenditure of *£3 11s. 6d.* is an under-estimate, as is usually the case with family budget expenditure figures on such items as tobacco, alcoholic drinks and entertainments. We had therefore, before using the family budget figures, to make allowance for items not included in the family budgets, such as expenditure on entertainment by the head of the family out of pocket money, *e.g.*, for Saturday afternoon matches. On this basis the following estimates were made:

Income group	Yearly expenditure in 1937-38	Average tax burden
£100	12s.-15s.	—
150	£2 10s.-£3 10s.	7s.
200	£4 10s.-£5 10s.	14s.
250	£7 10s.-£8 0s.	£1 3s.

We then estimated the expenditure of the middle and upper classes. Owing to the optional character of the expenditure, there are marked differences in individual habits. Our estimates based on a tax-paying family of four as compared with those of the Colwyn Committee are as follows:—

TABLE IV  
*The Burden of the Entertainments Duty on Incomes*

Income group	Colwyn Committee estimates (family of five— three children under the age of 10)		Our estimates (tax family of four)	
	1918-19		1926-26	
	£	s. d.	£	s. d.
100 ... ..	5	6	3	0
150 ... ..	7	0	4	0
200 ... ..	7	6	5	0
250 ... ..	—	—	—	—
300 ... ..	—	—	—	—
350 ... ..	—	—	—	—
500 ... ..	11	6	12	0
1,000 ... ..	17	6	1	0
2,000 ... ..	1	10 0	1	12 0
5,000 ... ..	2	0 0	2	5 0
10,000 and over ... ..	2	10 0	2	15 0

The estimate of the burden of the duty on incomes for 1941-42 was as follows:

TABLE V  
*The Burden of the Entertainments Duty on Incomes, 1941-42*

Income group				Burden of duty (tax family of four)			Income group				Burden of duty (tax family of four)		
£				£	s	d	£				£	s.	d
100	...	...	...		3	0	350	...	...	...	1	15	0
150	...	...	...		8	0	500	...	...	...	2	5	0
200	...	...	...		15	0	1,000	...	...	...	3	0	0
250	...	...	...	1	5	0	2,000	...	...	...	3	10	0
300	...	...	...	1	10	0	5,000 and over	...	...	...	4	0	0

These figures are, we believe, if anything an under-estimate.

### *Motor Vehicle Duties and Fuel Duties*

When Lord Samuel made his calculations, motoring was still undeveloped, and so he did not include in his estimates of the burden of taxation that due to motor vehicles. The Colwyn Committee, when they reported, did not refer to the petrol tax, as it was suspended from 1922 to 1928. In our Enquiry we included both fuel and licence duties, and calculated the duty paid on a private car in 1937-38 and 1941-42 for petrol, oil, and licence duty. The next step was to allocate this burden to the different income groups. We then took the number of private cars, excluding those used for commercial purposes, and assumed the owners of private cars are to be found within the group of people with yearly incomes of £250 or over. Our difficulty was to make a reasonable assumption about the income levels at which the keeping of a car is financially possible and probable, and some clue was provided by the cost of running a small car which in 1937-38 amounted to some 20s.-25s. a week, and we allocated the different-sized cars to the different groups of income. These assumptions were, of course, arbitrary, but were arrived at after consultation with the motor trade. The possible error was minimized by the fact that the tax burden on a small car and on a medium-sized car together equals the tax burden on a big car. The whole problem of motor vehicle duties and fuel duties will be found in Chapter XII of the Report. The burden for 1941-42 was calculated on the same principles as those for the year 1937-38, due allowance being made for the change of circumstances brought about by the war.

We then took the small indirect taxes such as the taxation of cocoa, coffee, chicory, dried fruits, patent medicines and table waters. Our calculations were based on the national per capita consumption and representative figures of expenditure in working-class and middle-class families based on family budgets. These family budgets were the Crawford Budgets of 1936, the Ministry of Labour Budgets of 1937 and 1938, and the Middle Class Budgets of 1938-39. The result shows that the working classes consume more cocoa than the middle classes, whereas the middle classes consume a far larger quantity of coffee.

The Processing Tax on Milling and Coal Levies were also included.

A word on Post Office net revenue, which was arrived at in consultation with officials of the General Post Office, the net revenue only being regarded as a tax burden—a conclusion which was previously reached by most of the authorities

who were consulted by the Royal Commission on local taxation. It would take perhaps too long in this paper to go into details of our method, but the main point is that we based our calculations on the net revenue and also on family budgets where working-class expenditure on Post Office services is mainly on postage stamps, postal orders, money orders and wireless licences. It will be noted that our figures of the burden on incomes refer only to the distribution of that part of the net revenue which is of non-business origin.

Finally, we had to deal with taxes allocated on general expenditure—protective duties, taxes on production in general, such as duties on industrial oil or on goods vehicles, and the purchase tax. The burden of these indirect taxes cannot be calculated on personal incomes in the same way as tea and sugar duties. They are not on goods purchased at regular intervals. There are difficulties apart from the fact that the purchase of the majority of the goods is irregular as: (1) it is not possible to de-limit the precise scope of these taxes. Protective duties are levied on many hundreds of imported goods for consumption and for protection of home-produced goods; (2) it is difficult to find out what proportion of the price paid for any particular goods or services can be regarded as tax on the assumption that it enters into price. In the case of the purchase tax the difficulty involved is not large, but in the case of protective duties an exact solution of the problem is almost impossible; (3) the very scanty information available about the expenditure of the community and of the different income groups in particular. We made, however, a study of the available sources of information. It will be sufficient if I give here a brief account of how we estimated the burden of one of these taxes on general expenditure—namely, the burden of the purchase tax, which is a form of sales tax levied as a percentage on the prices when the goods pass from the wholesaler to the retailer. The Government wisely saw that if the tax should be calculated properly it was essential to prepare a register of the wholesalers on whose sales to unregistered persons the tax was to be levied, and the burden of the tax was intended to fall on the consumer with the object of limiting civilian consumption in war-time. The consumer, under the Prices of Goods Act, 1941, is protected from exploitation, and also by the provision requiring wholesalers to show the amount of the purchase tax on their invoices to retailers. We were faced with the difficulty here that many of the goods subject to the purchase tax are bought at irregular intervals, and we had to make an estimate of the average burden per family—a lower middle-class and a working-class family. We have a guide to the expenditure per family on pre-war expenditure based mainly on *The Home Market* calculations,\* and checked from other sources. An estimate was made of the current expenditure of the community on purchase-tax commodities in consultation with the officials concerned with the tax. On this basis it was possible to arrive at the expenditure of £40 per annum at retail value, including the tax per family, and three-fifths of this amount was spent on goods liable to the lower rate and two-fifths on goods liable to the higher rate. On the average 14·2 per cent. of the retail prices inclusive of tax could be regarded as tax, corresponding to an average addition of about 16½ per cent. to the retail price, and the burden of the purchase tax per family was consequently of the order of £6 per annum. This figure will vary from one income to another, especially in regard to some classes of expenditure, such as, for example, clothes, although

\* *The Home Market*, 1939 edition (George Allen & Unwin, Ltd., London).

differences have been reduced by rationing. Another approach was made by estimating the current expenditure of an average working-class family on commodities subject to the purchase tax. This was possible by taking into consideration four facts: (1) The average decrease in expenditure on goods subject to the purchase tax; (2) the pre-war distribution of expenditure on commodities now liable to the tax and the estimated war-time reduction in this expenditure; (3) the great increase in the price of clothing since 1937, and the smaller, but nevertheless considerable increases in the price of other commodities; (4) the influence of the clothes rationing scheme on expenditure on clothing.

It must be admitted here that the burden is of the nature of a guess, but, all things considered, it cannot be very far from the truth.

I have in this paper been most anxious to put before the Society the methods we used, in order that when the bones are laid bare criticism may be made to improve any future calculations. The Enquiry which has been undertaken at University College, Exeter, is more comprehensive than any previous Enquiry, and the team research has yielded a harvest which was perhaps not anticipated when the Enquiry was undertaken. It was possible to enlist in each part expert assistance, official as well as unofficial. I may perhaps have given too many facts which are available in our Report; that is inevitable, as without these a discussion before the Society would have been impossible. I feel, however, that in addition to what I have stated, it is necessary to outline rather briefly some other methods of calculating this burden. I have dealt with this in Chapter XXIX, on "The Burden of Taxation," in the Second Volume of my *Science of Public Finance*.\*

It is not therefore necessary here to give anything more than in broadest outline the methods of estimating the total burden, especially where we are comparing one country with another. One method is to take the total taxation per head showing direct taxation separately from indirect taxation. The Colwyn Committee followed this plan, but did not make comparisons with other countries, although they stated that "It may be said definitely that the burden of taxation was heavier in Great Britain than in any other European country, and very much heavier than in the United States." The per capita figures in this country, for example, are striking: they are given in the following table:

*Exchequer Net Receipts from Taxation per head of Population in Selected Years*

(United Kingdom)

	1913-14	1925-26	1937 38	1941-42 *
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
From direct taxation ... ..	1 16 0	9 0 0	9 12 0	25 2 0
From indirect taxation ... ..	1 16 0	6 2 0	8 4 0	15 15 0
From total taxation ... ..	3 12 0	15 2 0	17 16 0	40 17 0

Based on estimated total population.

International comparisons require to be used with caution, owing to differ-

\* Macmillan & Co. Third Edition.





## THE BURDEN OF TAXATION ON FULLY EARNED INCOMES, 1937-38 AND 1941-42

Assuming a moderate Consumption of Alcohol and Tobacco and (on incomes of £500 and over) a moderate amount of Private Motoring  
(Husband, wife and two dependent children)  
(In percentage of income)

In- come, 1937-38	Income tax and surtax	Social insur- ance and contri- butions	Tea	Sugar	Small in- direct taxes	To- bacco	Alcohol	Enter- tain- ments	Transport			Post Office net revenue	Pro- tec- tive duties	Taxes on pro- duction in general	Pur- chase tax	Total direct taxes	Total in- direct taxes	Total burden of taxes out of earned incomes
									Private motor- ing	Buses and taxis								
£																		
100	—	3.5	0.5	1.2	0.4	3.0	5.0	—	—	0.4	0.1	0.1	1.3	2.5	—	3.5	11.4	17.9
150	—	2.3	0.4	1.0	0.3	2.7	4.7	0.2	—	0.3	0.1	0.1	1.0	2.8	—	2.3	14.1	16.4
200	—	1.7	0.3	0.9	0.2	2.6	4.0	0.3	—	0.3	0.1	0.1	0.9	2.9	—	1.7	13.5	15.2
250	—	1.4	0.3	0.7	0.2	2.3	3.6	0.4	—	0.3	0.1	0.1	0.8	2.7	—	1.4	11.9	13.9
300	—	—	0.3	0.6	0.2	2.2	3.3	0.4	—	0.3	0.1	0.1	0.8	2.7	—	—	11.9	11.9
350	—	—	0.3	0.6	0.2	2.0	3.1	0.4	—	0.3	0.1	0.1	0.8	2.7	—	—	11.8	11.8
400	—	—	0.1	0.4	0.1	1.6	2.3	0.4	—	0.3	0.1	0.1	0.8	2.7	—	1.7	13.8	14.5
500	1.7	—	0.06	0.2	0.1	0.9	1.5	0.3	2.1	0.1	0.1	0.1	0.8	2.7	—	10.8	9.0	19.3
1,000	10.8	—	0.03	0.10	0.03	0.46	1.5	0.3	1.9	0.1	0.08	0.1	0.8	2.7	—	16.4	7.1	23.5
2,000	16.4	—	0.03	0.08	0.03	0.4	1.4	0.3	1.3	0.08	0.08	0.03	0.6	1.8	—	19.3	6.5	25.8
3,000	19.2	—	0.01	0.04	0.01	0.17	0.9	0.09	1.3	0.08	0.08	0.03	0.6	1.8	—	28.3	4.9	33.2
5,000	28.2	—	0.01	0.02	0.006	0.09	0.6	0.05	0.7	0.08	0.08	0.03	0.6	1.8	—	38.5	3.8	42.3
10,000	38.5	—	0.003	0.01	0.003	0.045	0.3	0.025	0.7	0.08	0.08	0.03	0.6	1.8	—	47.5	2.0	49.5
20,000	47.5	—	0.001	0.004	0.001	0.018	0.12	0.01	0.243	0.084	0.003	0.003	0.1	0.6	—	56.6	1.1	57.7
50,000	56.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1941-42																		
100	—	4.4	0.7	2.0	0.4	7.0	8.0	0.2	—	0.4	0.1	0.1	0.6	1.8	1.8	4.1	25.2	27.6
150	—	2.9	0.6	1.5	0.3	6.2	7.3	0.3	—	0.3	0.1	0.1	0.6	2.1	2.0	2.9	21.3	24.2
200	—	2.2	0.4	1.1	0.2	5.6	6.5	0.4	—	0.3	0.1	0.1	0.7	2.3	1.7	2.2	19.3	21.5
250	—	1.8	0.3	0.9	0.2	5.2	6.0	0.5	—	0.3	0.1	0.1	0.7	2.1	1.6	1.8	17.8	19.6
300	—	1.5	0.3	0.8	0.2	4.8	5.3	0.5	—	0.3	0.1	0.1	0.7	2.0	1.7	1.6	16.5	18.2
350	8.2	1.3	0.2	0.7	0.2	4.5	5.1	0.5	—	0.3	0.1	0.1	0.7	1.9	1.8	1.5	16.0	17.5
400	15.2	—	0.2	0.5	0.2	3.6	4.3	0.4	2.6	0.1	0.2	0.2	0.6	1.9	2.0	1.5	15.2	16.7
500	30.1	—	0.08	0.3	0.07	2.0	1.8	0.3	1.8	0.1	0.2	0.2	0.6	1.9	1.5	30.1	9.7	39.8
1,000	38.8	—	0.04	0.1	0.04	1.06	1.30	0.18	1.7	0.03	0.09	0.09	0.3	0.9	1.2	38.8	7.2	46.0
2,000	43.1	—	0.03	0.05	0.03	0.81	1.4	0.14	1.4	0.04	0.07	0.07	0.3	0.8	1.1	43.1	6.2	49.3
3,000	56.1	—	0.015	0.02	0.02	0.42	0.84	0.08	0.09	0.02	0.037	0.037	0.1	0.7	0.9	56.1	3.9	59.0
5,000	67.8	—	0.007	0.01	0.008	0.21	0.42	0.04	0.346	0.01	0.018	0.018	0.1	0.5	0.5	67.8	2.3	70.1
10,000	80.5	—	0.004	0.003	0.004	0.105	0.21	0.03	0.173	0.005	0.005	0.005	0.03	0.3	0.3	80.5	1.5	81.7
20,000	90.7	—	0.001	0.003	0.002	0.043	0.084	0.007	0.068	0.002	0.002	0.002	0.03	0.2	0.1	90.7	0.6	91.3

ences in national wealth, financial systems and the social and economic structure of the countries compared. All these facts have to be taken into consideration. The best possible method is to consider the proportion of the total national income of each country taken in taxation. This gets over much of the difficulty arising from differences of wealth, population, social and economic conditions. In favour of this method we may urge the great advance in methodology in the calculation of national income in other leading countries in recent years. It is a method which I have followed in the complementary volume to the Report on British Taxation which is now in the Press—*Federal Finance in Peace and War*, where the tax burdens of the United States and the Federal countries of the British Commonwealth are analysed. This method is of value; for example, at

## APPENDIX II

## NET INCOME AFTER ALL TAXES

NOTE.—This table shows, for a married man with two children, the amount of his gross income left after direct and indirect taxation in 1937-38 and in 1941-42, both in the case of the earned and investment income.

Income	Fully-earned incomes		Fully-investment incomes	
	1937-38	1941-42	1937-38	1941-42
£	£	£	(a) £	(b) £
100 ... ..	82	72	(a) 84- (b) 84	(a) 75- (b) 75
150 ... ..	126	114	126- 126	116- 116
200 ... ..	170	156	170- 170	158- 156
250 ... ..	215	200	213- 213	198- 195
300 ... ..	264	237	258- 255	225- 222
350 ... ..	311	266	303- 303	252- 249
500 ... ..	430	345	400- 390	315- 300
1,000 ... ..	810	600	720- 690	530- 470
2,000 ... ..	1,520	1,080	1,360- 1,240	940- 720
2,500 ... ..	1,875	1,275	1,680- 1,480	1,100- 780
5,000 ... ..	3,350	2,050	3,050- 2,400	1,800- 1,250
10,000 ... ..	5,900	3,000	4,300- 3,300	2,700- 2,100
20,000 ... ..	10,000	3,600	9,000- 6,000	3,400- 2,800
50,000 ... ..	21,000	4,500	18,500- 15,000	4,000- 3,000

(a) Minimum estimate for Death Duties.

(b) Maximum estimate for Death Duties.

the beginning of this paper it was stated that the percentage of the national income taken in taxation had risen to more than 30 per cent. of the net national income in this country, and the latest figure supplied by the Dominions Statistician of Canada gives a figure of 32·3 for Canada as the percentage of national income taken in Government revenue. He also shows that the taxation per head is 183 dollars (or £41 2s.), as compared with £40 17s. in this country in the same year—1941-42. No definite percentage can, of course, be laid down, although the Hindoo law-giver Manu says: "A military king who takes even one fourth part of the realm at a time of urgent necessity as of war and protects his people to the utmost of his power commits no sin." He also laid it down as a principle of taxation to gather little by little "as the leach, calf and the bee take their food."

## APPENDIX III

## EARNED INCOMES

1937-38

1941-42

Income	Unavoidable taxes	Tobacco and alcohol	Other taxes	Total	Unavoidable taxes	Tobacco and alcohol	Other taxes	Total
£	%	%	%	%	%	%	%	%
100 ...	5.6	8.0	4.3	17.9	7.5	15.0	4.9	27.6
150 ...	4.0	7.4	5.0	16.4	5.3	13.5	5.2	24.0
200 ...	3.1	6.5	5.6	15.2	4.0	12.1	5.4	21.5
250 ...	2.6	5.9	5.4	13.9	3.2	11.2	5.2	19.6
300 ...	1.0	5.5	5.4	11.9	6.0	10.1	5.1	21.2
350 ...	0.9	5.1	5.3	11.3	9.3	9.6	5.3	24.2
500 ...	2.3	3.8	8.4	14.5	16.1	6.6	7.8	30.5
1,000 ...	10.6	2.4	6.3	19.3	30.4	3.8	5.6	39.8
2,000 ...	16.5	2.0	5.0	23.5	39.0	2.6	4.4	46.0
2,500 ...	19.3	1.8	4.3	25.4	43.2	2.2	3.9	49.3
5,000 ...	28.4	1.0	3.1	32.5	55.2	1.3	2.5	59.0
10,000 ...	38.5	0.7	2.1	41.3	67.9	0.6	1.6	70.1
20,000 ...	47.6	0.3	1.6	49.5	80.5	0.3	0.9	81.7
50,000 ...	56.6	0.1	1.0	57.7	90.7	0.1	0.5	91.3

In this paper I have avoided analysing the results of our Enquiry and confined myself to the methods. No one who studies the tables can fail to notice that the burden since the pre-rearmament year has very greatly increased, leaving very little for income in the highest ranges, as will be seen in Appendix II, and also that the system as a whole has become more equitable. Such points, however, are outside the scope of this paper, and one must be content with showing the methods which were followed in the Enquiry.

## APPENDIX IV

DIRECT AND INDIRECT TAXATION FROM 1903-04 TO 1941-42

Income	1903-04	1913-14	1918-19	1923-24	1928-29	1930-31	1937-38	1941-42
£	%	%	%	%	%	%	%	%
100 ...	5.6	5.4	9.9	14.1	11.9	11.0	10.4	19.1
150 ...	4.5	4.4	9.0	13.5	11.6	10.9	9.5	16.7
200 ...	4.8	4.0	7.9	11.8	10.2	9.6	8.4	14.8
500 ...	5.3	4.4	10.2	8.0	6.2	4.5	5.6	18.4
1,000 ...	6.1	5.2	16.9	14.1	11.0	9.7	11.8	32.2
2,000 ...	5.7	4.9	24.0	17.9	15.2	15.7	18.0	40.5
5,000 ...	5.5	6.7	36.6	28.5	23.2	26.3	29.2	56.1
10,000 ...	5.0	8.0	42.5	37.1	31.2	35.8	39.1	68.3
20,000 ...	4.9	8.3	47.6	42.3	37.5	43.5	47.9	80.7
50,000 ...	4.8	8.4	50.6	48.0	44.4	51.4	56.7	90.7

## APPENDIX V

## THE ESTIMATION OF THE BURDEN OF DEATH DUTIES

BY NICHOLAS KALDOR

1. Death duties are a recurrent tax on capital paid at irregular, but fairly long intervals. The income burden of a capital tax is the loss of income which

the reduction of capital, due to the tax, creates. In the case of a once-and-for-all capital tax, payable immediately—a Capital Levy—the calculation of the income burden is simple: it is the difference between the net income of the estate (net after payment of income tax and surtax) before and after the levy is paid. In the case of a recurrent tax on capital, payable at more or less distant future dates, the present income burden can only be ascertained by listing the future tax payments, calculating the present value of this series (discounting at the same rate of interest as that which relates the income of the estate to the capital) and finally relating this discounted value to the total value of the estate. It would follow, therefore, that the annual burden of death duties is a sum standing in the same proportion to the present annual net income as the present discounted value of all future death duties payable bears to the present value of the total estate.

2. This formula, however, requires some modification, on account of income tax and surtax. In so far as the payment of death duties reduces the size of the estate, it also relieves the estate from some of the taxes which would otherwise be payable in the form of income tax and surtax. The present discounted value which is relevant for calculating the net burden of death duties is not, therefore, the discounted value of the future death duties as such, but the difference in the discounted value of all future tax payments caused by death duties; in other words, the difference between (a) the discounted value of all future payments on account of income tax, surtax, and the death duties, and (b) the discounted value of the income tax and surtax that would have to be paid in the future if there were no death duties to be paid. It is the ratio which this difference bears to the total value of the estate which determines the proportion of net income which should be allocated to death duties.

Looked at in another way, the burden of death duties is the net reduction of the income-stream of an estate occasioned by them. This is shown, as a proportion of current net income, by comparing the discounted value of the expected net income-stream of an estate when there are no death duties, with the discounted value of net income-stream when future net income is reduced by successive death-duty payments. The proportion by which the second of these discounted values falls short of the first is the proportion of current net income which should be allocated to death duties. These two ways of approach must yield identical results if the rate on interest employed is the same as that which relates the income of the estate to the capital.

3. It follows from these considerations that the annual burden of death duties on present income can only be determined if definite assumptions are made not only as to the future rates of taxation (the future rates of income tax and surtax, as well as the future rate of death duties payable) and the future rates of interest, but also as regards the changes in the size of the estate in the lifetime of each generation, *i.e.*, the rate of saving or dis-saving, both present and future. The burden of death duties as a proportion of income will be all the greater, the greater the proportion of the income devoted to saving. Thus, if an estate-owner consumes the whole of his capital in his lifetime—by exchanging his capital for a life annuity, for instance—the estate escapes the payment of death duties altogether; while if the estate-owner in each generation “saves up” for death duties—so that the estate is passed on intact despite the payment of death duties—the actual amount of death duties to be paid, and thus the annual burden as a proportion of income, will be greater, and in some categories of

estates much greater, than if the size of the estate is allowed to be depleted by the payment of death duties in each successive generation.

4. The "insurance method," which was adopted by the Colwyn Committee, really amounts to a special case of our general formula, given above. If it is assumed that the owner in each generation saves an annual sum, the accumulated value of which is sufficient to allow the estate to pass intact to his successor—or, what (subject to a qualification made in paragraph 7 below) amounts to the same thing, if he takes out a life insurance policy which is sufficient to cover the total amount of death duties payable, including the increase in the duty due to the policy, and if he does not save otherwise—the net addition to the discounted value of all taxes payable caused by death duties is just equal to the discounted value of the death duties paid (since, in this case, there is no reduction in capital in successive generations, hence no reduction, consequent upon death duties, in the payments of income tax and surtax); and the annual burden of death duties (if the rate of interest used in discounting is the same as the one at which the savings are accumulated) is just equal to the annual savings. In this case, therefore, but only in this case, the annual burden of death duties can alternatively be looked upon either as the interest on the discounted value of net death-duty payments, or the annual savings, made out of income, which provide a "special fund" out of which death duties are paid.

It will be readily seen, however, that by "saving up" for death duties estate-owners make the estate liable to much heavier payments of death duties than would be the case if they did not save up for it. This is partly because the size of the estate is increased by the accumulated savings; partly also because the more distant death-duty payments, made by successive heirs to the estate, will be on a constant amount of capital, instead of on a diminishing amount. The annual burden of death duties, as calculated by the "insurance method," cannot therefore be regarded as the burden of death duties, applicable in all cases; or, rather, it is only applicable in those cases where estate-owners do, in fact, save up a sufficient amount to leave their property intact to their successors. It is unlikely that this is the usual practice, especially for the larger estates.

5. For certain categories of property-owners it may well be the case that savings made during lifetime are sufficient, or more than sufficient, to cover the payment of death duties on inheritance. In those cases, the insurance method, if properly calculated, gives the correct approximation of the true burden. But in the case of estates beyond a certain critical size—this critical size was the estate of £331,000 with the tax system of 1937–38, and of £86,000 with the tax system of 1941–42—it would be futile for estate-owners to save up for the full amount of the death duties, for this policy would leave the estate with a smaller permanent net income (after paying income tax and surtax) than would be obtained if estate-owners saved less. For still larger estates, it would be impossible to save up for the full amount; and here the assumptions of the insurance method yield nonsensical results. For these estates—which were estates of more than £1,072,800 in 1937–38 and of more than £190,000 in 1941–42—the necessary annual insurance premium, together with income tax and surtax, would amount to more than the total income of the estate, so that the insurance premiums could only be paid out of capital (with the result that at death the size of the estate, and hence the death duties to be paid, would be smaller than the amount on the basis of which the insurance premiums were calculated). Thus the insurance method is a sensible method of calculating

the burden only for estates below a certain size; and it is the correct method only if the typical estate-owners in those categories do, in fact, behave in the manner assumed, and save up during lifetime, either by insurance, or in some other way, an amount sufficient to cover death duties.

6. The particular form of the insurance method adopted by the Colwyn Committee suffers, moreover, from another defect: it was there assumed that estate-owners take out an insurance policy at the age of 45. The age at which the policy is taken out cannot, however, be arbitrarily chosen; since the purpose of the calculation is to provide the equivalent of a constant annual burden, the age assumed for taking out the life insurance policy must be such as to provide an expectation of life which corresponds to the average length of a generation, *i.e.*, the average interval of time during which the estate remains in the possession of a single owner. With the present life expectation the Colwyn Committee's assumption of the age of 45 for taking out a policy implies an average length of generation of 25·5 years. The average length of a generation is, however, about 31 years. Hence the right assumption is, for this method, that the policy is taken out at the age of 38, since this gives an expectation of life of 31 years.

Calculations prior to the Colwyn Committee's—such as one given by the Chancellor of the Exchequer in answer to a Parliamentary question in 1918 and Sir Herbert Samuel's in 1919—assumed the age of 40, which might well have been the right figure for that period, since it is likely that the age at which parents beget children has risen somewhat in the meantime.

7. It follows from what has been said above, that the correct approximation for assessing the annual burden of death duties can only be obtained by taking into account the expected increment in the size of the estates between inheritance and death, as inferred from the actual rate of savings in the various income groups. Unfortunately, however, there are no data available for the distribution of personal savings in various income categories. The only possible way of proceeding therefore appeared to be to work out the burden of death duties for two special cases, which might be looked upon as the limits within which the actual burden, in the great majority of cases, is likely to fall. The estimates of burden thus derived can, with some looseness of language, be called the Minimum Burden and the Maximum Burden.

The first assumption, that of the Minimum Burden, the results of which are given in Table 21 below, is that the estate-owners of the present, and every successive generation, maintain their capital constant during lifetime (*i.e.*, that there is zero net saving during the lifetime of each generation), so that the value of the estate inherited by the  $n$ th heir is equal to the estate inherited by the  $(n-1)$ th minus the death duties paid on his death. Here the amount of death duties to be paid by successive generations will be a diminishing series, since the estate will be smaller on every successive inheritance. The figures in Table 21 were so arranged as to show the calculation of the burden by both methods mentioned in paragraph 2 above—as the difference caused by death duties in the discounted value of future net income. Thus, column (3) shows the discounted value of tax payments, on the assumption that the estate yields the present income permanently and no death duties are paid. Column (6) shows the present discounted value of all future death duties payable, and column (7) the present discounted value of income tax and surtax payments, when the size of the estate is reduced in successive generations by the death-duty payments. Thus the difference in the corresponding figures between column (3) and column (7)

shows the reduction in the payment of other direct taxation resulting from death duties. Alternatively, column (4) and column (8) show, respectively, the discounted value of net income in the absence of death duties, and allowing for death duties. Column (9) brings the two methods together. It shows the discounted value of the net burden of death duties, and it equals either column (6) minus the difference between columns (3) and (7) or the difference between columns (4) and (8). Finally, this discounted value is converted into a net annual burden in column (10).

The second assumption, that of the Maximum Burden, the results of which are given in Table 22, is that estate-owners in each generation save out of income an amount sufficient to maintain the net income of the estate constant over successive generations, in spite of the payment of death duties, so far as that objective is attainable. Up to a certain capital level—the “optimum estate”—which, as mentioned earlier, was an estate of £331,000 in 1937–38 and of £86,000 in 1941–42, this assumption implies an annual rate of savings the accumulated value of which is just sufficient to pay the death duties (including the increase in death duties due to accumulation) and leave the estate intact to the successor; it is identical, therefore, with the assumptions made by the Colwyn Committee. Beyond that critical level, however (*i.e.*, for estates which are larger than the optimum), the assumption of maintaining the capital intact would have produced a smaller net income than could be obtained on the optimum estate. For the owners of these estates it would therefore be pointless, if not impossible, to maintain the capital intact. In fact, for the owners of these estates it would be pointless to save up anything at all for death duties, since by doing so they cannot prevent the reduction in the size of the estate to the optimum level; by saving they merely postpone the time at which the estate is reduced to the optimum level, at the cost of sacrificing the income from the estate in the intervening period. Saving only becomes worth while after the estate has fallen to the optimum level.

For these estates (which are those calculated by Method (c) in Table 22) it was assumed that annual savings out of income are equal to the savings on optimum estates. This, of course, is purely arbitrary; to assume that the owners in these categories saved nothing at all would have given results identical with Table 21, whereas the whole purpose of Table 22 is to show the added burden of death duties due to savings; moreover, it is justifiable to assume that owners of large estates do, in fact, save something out of their income, and, to that extent, make themselves liable to larger payments of death duties.

It will be noted that these assumptions make the annual burden of death duties (the Maximum Burden) identical with annual savings for estates which are less than the optimum and more than the annual savings for estates which are greater than the optimum.

For estates which are less than the optimum, it was assumed that savings take either the form of direct accumulation (at the same gross rate of interest which relates the income to the capital of the estate) or else the form of life insurance premiums, whichever secures the higher net income. For the lower categories of income (those calculated by Method (a) in Table 22), which are not subject to income tax, or else pay income tax at a reduced rate, direct accumulation yields the lower burden, for the reason that the income from investments of insurance companies is subject to income tax, and insurance premiums carry therefore a lower rate of interest. For higher categories of incomes (those



calculated by Method (b) in Table 22)\* savings in the form of life insurance yield a higher net income, largely owing to the income-tax rebates which are allowable on insurance premiums but not on other forms of saving.

#### DISCUSSION ON THE PAPER BY PROFESSOR SHIRRAS

Dr. R. G. HAWTREY: This is one of the occasions when the reader of the paper deserves two-fold thanks, not only for reading the paper, but for compiling the report which forms its subject. He has asked us particularly to turn our attention to the methods pursued, but that is not very easy, because these methods are rather elusive, and much consists of guesswork. When a practical problem has to be tackled, and the data are not available, or only partly available, the only refuge is guesswork, and the function of the scientific statistician is to make the most not only of the data, but of his power of judgment. This the report endeavours to do with a considerable degree of success.

The data used as a basis for the guesses are far too voluminous to be reproduced, and we have had to trust to the judgment of the compilers and take a great deal for granted. At the same time they have shown how they proceeded in quite considerable detail, and it would be difficult to find serious fault with the report on the score of method.

There is one fundamental difficulty which I do not think the report brought out. The problem to be tackled, I think, was this: Given the policy embodied in the graduation of British taxation, how much allowance has to be made for the other taxes? The income tax and surtax are based on the taxable income, and in order to find to what extent the other systems modify or add to the taxation, it is necessary to consider the zones of income and that is the object of the report.

The other taxes, however, do not accommodate themselves to that; the burden allotted to an income zone is in general an average, probably for a commodity such as sugar it is a fairly significant average, but when it comes to the drinkers and smokers, the report frankly gives it up, and lays a great deal more stress on calculations which are simply the outcome of the independent judgment of the compilers. I do not think we have any reason to find fault with that: but innumerable different results might have been found in the same way.

There is a further difficulty apart from consumption taxes; the vexed question of the death duties. The fact is that fortunes do not fit much better into income zones than drinkers; just as there are heavy drinkers, so there are heavy fortune-holders, and it is quite a mistake to analyse the effect of death duties exclusively on rentiers who derive the whole of their income from capital. If you turn from them to the man who in the course of his life has a fluctuating and growing income, the whole classification of incomes breaks down altogether. It might be said that it is desired to measure the incomes of people in an income zone at any moment. But that will not do because they look forward to future changes in their incomes, so that there are not three but a hundred categories of different combinations of capital and income and different uses of capital, capital which is earning 3 per cent. or  $\frac{1}{2}$  per cent., and capital which is earning 10 or 50 per cent. It is an insoluble problem to sort out fortune zones as if they were the same thing as income zones.

There are some ingenious attempts to determine what the burden of death duties is on a rentier whose income is deemed to remain unaltered throughout life, and with Mr. Kaldor's new suggestion for that I have no fault to find. It is ingenious, and within its limits quite convincing, but it covers only a small part of the ground.

\* For Tables connected with this Memorandum see Report, pp. 91-96.

It is no more legitimate to treat the insurance contribution as a burden than it would be to treat the gross Post Office revenue as a burden, because the amount paid by the taxpayer is repaid by a *quid pro quo*, and I would propose to omit the insurance contributions.

Another minor point is that the report includes the burden on the consumer of the subsidy in aid of sugar. That is similar, in principle, to including all protected commodities as part of the tax burden on the consumer. Here is an impenetrable morass, and I think the £8,000,000 for sugar should be omitted.

With regard to the classification of tax-paying families, the report does not reveal that only a minority of tax-paying families are married couples; the majority are single or widows or widowers, and there is a very wide variety in the small income zones which is not taken into account. The household budgets, for example, take no account of domestic servants. Each one of these servants is a tax-paying family, and his cash income is enormously smaller than his economic income. That is a complication which it would take a long time to explore, and I do not know that the materials for its exploration are available.

I have much pleasure in proposing a vote of thanks to Professor Shirras.

Dr. C. OSWALD GEORGE: It gives me great pleasure to second this vote of thanks. First of all I should like to congratulate Professor Shirras on his courage in reading this paper, because he is, in effect, submitting for our criticism and discussion the book which he and Dr. Rostas recently published, and few authors would care to submit themselves to such an ordeal.

But I am glad he has done so, firstly, because the subject of tax burden will play a great part in war and post-war discussion, and any figures of this description should be subjected to the fullest discussion, preferably—as was done with the Colwyn Report—before publication; secondly, because Professor Shirras' figures may, in time, if not at once, be regarded as being official, partly because of their inherent qualities and characteristics, partly because the book may be referred to as "the Report," as it is in fact in the present paper, and lastly because the calculations were initiated and published by the National Institute of Economic and Social Research. So far as I know, the adoption of the title of National Institute confers no special privileges, but it does, I think, bring special responsibilities, because in some quarters its publications are regarded as being official or quasi-official; but if the Institute is convinced by the discussion which takes place to-day that these figures are incorrect or misleading, I feel sure it will give equal publicity and authority to any necessary explanations or amendments.

Personally I have nothing to say against the calculations, in fact, I have the highest admiration for the way in which they have been carried through, but I think the way in which the results have been presented makes them, if not meaningless, at least misleading. To present these figures as a measure of burden gives not a true picture, but quite the reverse. We are warned, admittedly, that there must be no judgments in equity unless we take account of expenditure, but many people will forget that. I even wonder if the authors forget their own warning when in their book they construct detailed diagrams purporting to show the regressive "burden" of taxation, or when they talk about comparisons between years, classes or countries, which are quite meaningless unless we take full account of expenditure.

To talk of the "burden" of total taxation while ignoring the benefits of total expenditure seems to me as meaningless or misleading as to talk of the burden of the price of one's house while ignoring whether it is bought above or below market price and the amount of rent payments saved. Again, what can be the meaning of the burden of the food taxes on the poor if we ignore the food subsidies, which may be much greater? And coming down to greater detail, what can be the meaning of the "burden" on the poor of the tax on tea, if we ignore the subsidy on tea? Next we come to workers' compulsory contributions

to the Social Services which, being treated as wholly burdens, explain some of the authors' strange figures and graphs; it would be interesting to know the reaction of the people who recently agitated to become voluntary contributors, or, in other words, wanted to pay double contributions in order to accept the so-called burden. A third point is the exclusion of post-war credits, which, if allowed for, would substantially affect the "burden" on the lower incomes. The fourth point relates to the £100-a-year man; the curves which are so impressive in the diagrams are dominated by that lower income level of £100, and it would be interesting to know where we should find a man in 1942 with a wife and two children who earns only £100 a year and spends over a quarter of his income on beer and tobacco, and in what way he is typical.

On the question of death duties, which the authors handed over to Mr. Kaldor, I am sorry to differ fundamentally from such a high authority as Dr. Hawtrey, but I am not convinced by these figures. Those of you who have a copy of the authors' book will find that on page 91, Mr. Kaldor has, by the use of extraordinary assumptions, obtained results which are extraordinary—which, after all, is not extraordinary. Assuming eternally fixed rates of taxes and interest, with zero net saving, and deducting income tax never paid on income never received, he declares that on a £50,000 estate, the total estate duty burden is really only £1,800; on a £250,000 estate, only £6,500; on a £500,000 estate, only £5,750; and on a £1,250,000 estate, the total burden is only £6,400. Mr. Kaldor then reduces these figures to annual burdens of, respectively, £72, £260, £230, and £256. In other words, with an estate of £1,250,000 on which the actual death duties amount to, say, £660,000, the "annual net burden" would, according to these extraordinary calculations, amount to only £256. If a dead man whose estate had to pay death duties of £660,000 were told that his annual burden was only £250, he might well rise from the grave.

Where is the catch? Apart from the deduction of hypothetical income-tax savings, we may find the fundamental error illustrated in the example Mr. Kaldor himself chooses of a once-for-all capital levy, where he says, "the calculation of the income burden is simple: it is the difference between the net income of the estate (net after payment of income tax and surtax) before and after the levy is paid." If a wealthy man had to pay a capital levy of £500,000, Mr. Kaldor would tell us that his total net burden was about £5,000 and his "annual burden" only £200. The man in the street would say "That is just nonsense", and I should be inclined to agree with him. We are not concerned with a hypothetical burden spread over eternity, we are concerned with the amount of tax paid in a given year, and if a man has to pay £500,000 tax in that year, surely the burden is £500,000. The same principle may obviously be applied, with the necessary adjustments, to the death duties. Mr. Kaldor's figures would be correct only if he made two further assumptions: (1) that the dead man is allowed by the Treasury to pay death duties by yearly instalments spread over eternity, and (2) that the Gods grant him the gift of immortality on condition that every 31 years he dies, pays death duties, and comes to life again.

In spite of these criticisms—and I think Professor Shirras has come for criticisms—I feel the other figures may be of great use provided they are used not as final results, but merely as a starting point for further calculations in which full account will be taken of the benefit of public expenditure. Such calculations might be made for certain years and specified income levels in typical occupations, miner, merchant, farm labourer, city worker—employed and unemployed. To permit comparisons at different periods, it would clearly be necessary to allow for changing wage levels; it is meaningless to compare the burden on a £100-a-year man in 1942 with that on a £100-a-year man in, say, 1902. Furthermore, it would be of interest to calculate the net burden or benefit of public finance at different periods on certain sections of the income pyramid—say, on the lower half or the upper tenth.

Such calculations would, I think, be of great value to social students. Professor Shirras and Dr. Rostas have by their work shown themselves admirably fitted for this task, and I hope they will be able and willing to undertake it.

MR. NICHOLAS KALDOR said that the new method of assessing the income burden of death duties struck many people as something extraordinary, whereas it was merely an application of the economist's notion of "capital" and "income" to this particular problem. The traditional method of dealing with this problem (such as the Colwyn Committee's)—which assumed that the estate owner saved up for death duties just enough to pass on to his successors the same amount of capital that he had received—would be wrong even if it did not lead to absurd results, because the very process of saving up for death duties increases the burden, since it increases the size of the estate at death. Death duty was a deferred tax on savings, and the burden of death duty varies according as the owner of the estate saves out of income or dissaves. If he did not actually save, it would be just as illegitimate to debit him with the tax he might have to pay if he saved a certain hypothetical amount, as to the debit the non-smoker with the tobacco tax he would have to pay if he were a smoker.

In the actual case this hypothetical behaviour involves a total burden of taxation (for certain income ranges) which is far in excess of 20s. in the £; in which case the results are nonsensical. They do not show the total tax burden, on income, in any significant sense of the term; or even the annuity-equivalent of all the sums paid, in the course of time, in taxation; since when the total of taxes exceed income, the annual premia (for death duty insurance) have to be paid out of capital; the capital is therefore depleted, hence the size of the estate at death, and the death duties payable on it are necessarily smaller than the amount on which the insurance premia were calculated. It is regrettable that the Chancellor of the Exchequer should have recently reproduced in Parliament meaningless calculations of this kind.

Any method which suggests that an estate owner paid more than his whole income in taxation is clearly absurd; if that were really the case, the possession of the estate would be a liability and not an asset, and he would be better off without it. If a millionaire had a negative income he could convert it into a positive one by the simple process of giving away a sufficiently large portion of his assets. And since even the richest man prefers being richer to being poorer, he must clearly derive some net advantage from his possessions.

The real trouble with these calculations lies in mistaken notions about the concepts of "capital" and "income," and of the nature of taxes on capital and income. So long as the value of capital is positive, the income derived from that capital cannot be negative—or conversely, if the possession of a certain asset yields a zero, or a negative income, the possession of the asset could bring no advantage to its owner and would have no value. The contrary view arises from a mistaken definition of income, according to which income over a period is whatever remains after maintaining intact the money value of capital at some given initial date. But capital value itself is nothing else than the discounted sum of income expectations; if expected income falls, the value of the source of that income will fall, and the maintenance of the initial value of capital would be pointless and might be impossible. That does not mean, however, that the source no longer yields an income, or yields a "negative income."

Let us, for example, take a company which initially had an annual income of £50,000, with its assets valued at £1,000,000, and let us suppose that owing to some act of God or the King's enemies half the assets of that company are expected to be destroyed every ten years. Instead of enjoying £50,000 a year permanently, it will now have a series of annuities—£50,000 in the first ten years, £25,000 in the second ten years, £12,500 in the third ten years, and so on. Clearly, it would be impossible for that company to build up an amortization fund which would preserve the initial capital intact, even if it set aside the whole of the net receipts of the company for that purpose. But that does not mean that the company will no longer have an income, or that its assets will have no value. The market value of the assets will fall, and the company's "income" will fall in the same proportion as its market value. In other words, in determining amortization out of current receipts the company would be guided by the same principles as a company with "wasting assets," such as a gold mine.

The millionaire whose estate is periodically subjected to death duties is also in possession of a "wasting asset," and his net income should be determined on the same principles. There is a difference, however, between his position and that of the company—and this difference, perhaps, is the real reason for there being so much confusion on the subject—in that the millionaire's assets (unlike that of our hypothetical company) will not be physically destroyed by being subjected to death duties, only their ownership changes; the burden of the duty is on a *particular owner* of the assets, and not on the assets themselves. Hence the market valuation of his assets will take no account whatever of the death duty liability—the estate, and the assets composing it, are a "wasting asset" from the point of view of the particular owner, but not from the point of view of the market as a whole. This explains, perhaps, why previous attempts of determining the annual burden of death duties always proceeded on the assumption that the "present value" of the estate should be kept intact, when this "present value" was interpreted as the market value, and not as the capitalized net receipts of the particular owner (and his descendants) which of course is much less. If the correct method is followed, it can be shown that the net income from the estate can never be negative; and that the net income must necessarily be greater, the larger the estate.

MR. A. D. WEBB said that Professor Shirras had made a valiant attempt to solve an intriguing and difficult problem, that of ascertaining the amount of taxation paid by representative taxpayers at successive levels of income. He stressed the word "representative," because that was the whole essence of the enquiry. The tax system fell into three broad sections: the income-tax section, which was reasonably manageable, as the results had shown; the death-duty section, upon which he was not competent to speak but he felt unconvinced that Professor Shirras and Dr. Rostas had followed the right lines in connection with death duties, or, indeed, whether any investigator had done so, for two reasons, the first of which was that the various investigators had produced results entirely different from one another, and, secondly, he had yet to discover who was supposed to bear the death duties. Who was the victim on whom the burden actually fell? In a large number of cases the owner of accumulated wealth did not trouble in the least about the death duties which would fall to be paid at his death, in which case it was absurd to say that the burden fell on the man who owned the wealth when alive. On the other hand, it seemed to be an abuse of words to say that the death duties fell on the heirs who had come into possession of a windfall. The mere fact of a man receiving an unearned legacy of £15,000 instead of £20,000 did not mean in any real sense that the State had imposed a burden of £5,000 on him in respect of death duties. The speaker was therefore at a loss to know who really did bear this burden of death duties.

The third section was indirect taxation, and he thought the problem with regard to that was insoluble. Apart from tea and sugar, about which there was a good deal of information available, nobody knew from the existing data the average consumption of dutiable articles. Beer, spirits and tobacco yielded over £600,000,000 of revenue last year and would yield considerably more this year, and were therefore highly important, but nobody knew the number of consumers of beer, spirits or tobacco, nor even the total consumption in the form in which consumers used these articles. Nor was the distribution among consumers in different income groups known. The consumption of drink ranged from nothing at all at one end to the heavy drinker at the other, and in the case of tobacco it ranged from nil to 1,500 cigarettes a month. In these circumstances what average could be taken as applying to the "representative tax-payer" in respect of these commodities?

Even if the information were available as to the quantities consumed and the ways in which they were distributed, there would still be the problem of deciding the amounts of duty paid. Two people with the same rate of income

might be beer-drinkers; but one might like a heavy beer, say Guinness, and the other a light beer, and therefore they would not pay the same amount of duty simply by drinking the same amount of liquor, because the duty varies with the strength of the beer. The same sort of thing applied to tobacco-smokers. The man who smoked 100 Gold Flake cigarettes did not pay the same amount of taxation as the man who smoked 100 Woodbines; or the man who smoked Rhodesian tobacco the same amount as the smoker of a like quantity of Virginian tobacco.

What was important in this connection was that the difference in duties paid by the taxpayers might depend not at all on the amount of income but on the personal tastes of the consumers. In face of these lacunae in our information it was impossible to produce a convincing solution to the problem under discussion.

Professor Shirras had asked for the views of Fellows on the methods pursued in his inquiry. He (the speaker) thought that the method followed for indirect taxation was the only one which could be properly adopted, and it had indeed been pursued by Lord Samuel and the Colwyn Committee. In essence, this method of ascertaining the burden of indirect taxation on the people of this country was simply to imagine particular cases, assume certain amounts of consumption, and calculate the burden of the duty on those amounts. Having done that one obtained a result—and this was where Mr. Webb quarrelled with Professor Shirras—which was not the burden of taxation on a “representative” taxpayer (who was undiscoverable), but only the burden of taxation on those particular consumers who happened to buy the dutiable commodities in the quantities and qualities assumed.

MR. PETHICK-LAWRENCE felt that it was exceedingly important that the figures produced in the paper should not be torn away from their context and they should not be isolated so that people with less circumspection might quote them without understanding their limitations. It was commonly recognized that one of the great difficulties of economics as a science was that economists must use popular words. It was therefore of the highest importance that they should be clear about their definitions. Different economists, statisticians and politicians defined words in a different way, and sometimes economists did not define the words used in the same manner in their own writings.

An example of this was the word “tax.” The authors of these statistics used the word “tax” in a sense entirely different from that used by the Chancellor of the Exchequer. War-damage contribution was treated as a tax in the paper, but not in the House of Commons; the contributions paid by the employer or workpeople towards health insurance were described as tax by the authors, but were not recognized as a tax by Parliament. He noticed that motor duties were called “indirect” taxes, whereas according to the Chancellor of the Exchequer they were a direct tax. They must therefore be very clear in their definitions, or they would find themselves in great difficulty.

Another point which made it very important that they should understand what they were doing was that the amount paid could not be separated from the benefits upon which it was spent. If a child was sent to a school where the parent paid for the schooling it was not called a tax, but if the Government took the school over and the parent paid a contribution to the Government it would be called a tax. That of course reached its climax when the money paid in tax was used to reduce the cost of living, as in the subsidies. If the use of the proceeds of taxation were to be excluded, one was reduced to the rather absurd position that if a tax of 1d. was put on sugar it was called a tax, and was still so called even if the proceeds were used to contribute to a subsidy to reduce the price of sugar. The point of these remarks was to call attention to the fact that whoever used these figures must do so knowing the basis on which they were calculated.

The paper gave an international comparison, and here again care must be

exercised. If it was the habit in one country for insurance to be effected through private institutions, and in another through the State and the contributions in the latter case called a tax, there would be an apparent difference between the two countries which might not exist at all in practice. He wished to enter another caveat against the idea of comparing the taxation of two countries by taking a proportion of the total income of the country which went to the State. If the State consisted of a large number of individuals whose incomes were in the neighbourhood of £200 or £300 a year, an average tax of £30 would be far more severe than if the country consisted of millionaires; and this had to be borne in mind when making a comparison between one nation and another.

Finally—and this was of particular importance at the present time—care must be taken in comparing one year with another some decades ago. When he was a boy the community was broadly divided into the rich and the poor. The rich were the people who paid income tax, who wore a collar and tie and a black coat, and the poor were the people who worked with their hands and were never more than three weeks away from the possibility of the poorhouse. Now the population could be divided into three: the rich at one end, corresponding roughly to those who paid surtax, the poor at the other end, those about whom there was difficulty at the time of evacuation, but in between there was some 80 per cent. of the population. The outstanding change was that that 80 per cent. constituted one people at the present time; they wore the same clothes, ate the same food, lived the same life, did, to a certain extent, the same work and paid the same taxes. The change in the income tax affected very much the relationship of the classes. The astounding fact of the present day was that the great bulk of the population were really one people with the same kind of habits and life, and with one attitude towards the problems of the day.

SIR WILLIAM ELDERTON found himself in almost complete agreement with Dr. George and Mr. Webb when they said it would be better, when dealing with death duties, to treat them as a lump sum and not turn them into an annual equivalent. If, however, they must be turned into an annual equivalent, it was a simple actuarial calculation to say that the sum payable at the death of a person age  $X$  was equivalent to a certain annual sum during the remainder of his life. This does not assume that insurance is effected, but the arithmetical result may be nearer that obtained by the method of the Colwyn Committee than that obtained by Mr. Kaldor's method. He suggested that the difficulty which Prof. Shirras and Mr. Kaldor found arose because they had not distinguished between a straightforward actuarial calculation which was merely a method of valuation and a method of meeting death duties by effecting insurance which had become unrealistic because no very wealthy person could use it. If they looked at it as a valuation, they could not say that it implied that a man "or his heirs would be better off if he had less property."

With regard to the Appendix by Mr. Kaldor there were so many criticisms he could make that he would exceed the time allowed to speakers, so he would confine himself to one; Mr. Kaldor said that if an estate owner exchanged the whole of his capital for a life annuity he escaped the payment of death duties; as written like that it was perfectly correct, but would it not have been as well to point out that by the process of exchanging his capital for a life annuity he would pay far more tax than he would by any calculation on the death-duty basis?

Note added by Sir William Elderton:—The valuation method mentioned in my remarks means that we should use as the annual equivalent during the life of a person aged  $x$  to death duties of  $D$  payable at death  $DA_x/a_x = DP_x$ , or, ignoring the refinements of continuous functions,  $DP_x$ , where  $P_x$  is a tabulated function for many tables of mortality at many rates of interest. For the sake of non-actuarial people,  $A_x$  is the symbol for the value of a unit payable at the moment of death of a person aged  $x$ , and  $a_x$  is the value of an annuity

of a unit payable continuously throughout the remainder of his life.  $P_x$  can be taken from tables based on suitable mortality (not necessarily that of the general population) and the rate of interest must be either (i) the gross rate of interest yielded by the estate or (ii) the net rate after allowing for income and surtax (this will make the rate of interest low for large estates and will make  $DP_x$  approximately equal to  $D/e_x$ , where  $e_x$  is the expectation of life) or (iii) such a rate of interest (a negative one for large estates) as would result from allowing for income tax, surtax and the annual equivalent to death duties. If Professor Shirras wants to "temper the wind to the shorn lamb," he would argue for the use of the gross rate of interest and a low average age for  $x$ .

May I indicate some of the difficulties in accepting the method suggested by Mr. Kaldor and used by Professor Shirras by asking these questions?

1. If we take three men, A, who has a capital of £2,000,000 and an unearned income therefrom of £60,000, B, who has now a capital exactly equal to that to which A's will be reduced at A's death by death duties, and C, who has now a capital exactly equal to that to which B's will be reduced at B's death by death duties, what are the exact annual equivalents by Mr. Kaldor's method?

2. What would be the result by Mr. Kaldor's method if all estates were handed down in the way that actually happens if there is no will?

3. If Mr. Kaldor's method be adopted and we were to assume that a large estate (a) will always pass in entirety to a single successor or (b) will always be divided equally between two or more successors or (c) is left to a charity, would the present value of the annual equivalents in perpetuity be necessarily equal, on each supposition, to the present value of all the assumed death duties chargeable in future to the estate? And at what rate of interest?

4. If a method goes in any way into a hypothetical future beyond the death of a present owner, why should it not go back into a hypothetical past?

5. Would Professor Shirras be content, if it could be obtained, to measure the annual cost of death duties to men having an unearned income of £ $x$  by calculating the average yearly amount paid in death duties in a year (or the average of a few years) by the estates of those people who at the time of death had an unearned income of £ $x$ ? If not, why would he consider it wrong?

MR. KALDOR'S reply:—The method proposed by Sir William Elderton in his Note is substantially the same as that worked out by Barna, in "The Burden of Death Duties in Terms of an Annual Tax," *Review of Economic Studies*, November, 1941, pp. 28–39. Certain objections against the use of this method as showing the income burden of death duties were pointed out in the *Review of Economic Studies*, Summer, 1942, p. 146.

The merits of these two methods clearly depend on one's views as to what constitutes the "income burden" of a tax on capital. In Sir William Elderton's view it is not only the loss of income consequent upon the loss of capital, but also whatever additional sum is necessary to "make good" the loss of capital, i.e. to maintain the initial value of the capital intact. Would Sir William Elderton apply the same method if, after the war, a Capital Levy were imposed (say in order to repay the National Debt) and he were asked to calculate the income burden of the Levy? And would he (or could he) use the same method in all those other cases where the maintenance of the initial value of capital is impossible because the tax system is so framed that the estate could not be kept at the initial value, whatever the estate owner may or may not do?

As regards the questions posed by Sir William Elderton, (1) and (2) could not be answered without additional information; the answer to (3) is that the present value of the annual equivalents in perpetuity would not be equal to the present value of all the assumed death duties chargeable in future to the estate, but to the present value of the net additional sums payable in



taxation in the future, on account of the existence of death duties, if the discounting is done, in each case, at the rate of interest which relates the income of the estate to the capital. The answer to (4) is, because 'byegones are byegones'; the answer to (5) is that the proposed method would be wrong, as a measurement of the income burden of death duties, for the reasons stated above—because it would include not only the loss of income, but also the cost of replacing the lost capital. The sum of the annual equivalents under my method is not equal to the total receipts of the State from death duties in a given year, but to the interest on the present capitalised value of all future net receipts of the State on account of death duties, from all existing estates.

MR. G. L. SCHWARTZ wished to reinforce the criticisms made by Dr. George and Mr. Pethick-Lawrence. He thought that Professor Shirras had earned these criticisms by his persistence in using the term "burden of taxation." It was impossible to use that word "burden" except in a subjective sense. The task of the inquiry was to estimate how much was paid in taxation, and later on the reader was told that "taxation" was defined as any compulsory contribution to public funds. Why did not the author confine the inquiry within those limits, employ the term taxation objectively and eschew a title which indicated that it was a burden? A parallel enquiry could ascertain how much husbands handed over out of their incomes for housekeeping money. The results would be of great sociological value. But whatever the view of husbands it would be unwarrantable to represent the totals as "burdens" on the households. An estimate could be made of expenditure in shops, taking no account of the benefit received, but would there be any sense in heading the paper "The Burden of Retail Shopping"? As he pointed out in a paper he read to the Society last year, not only were the estimates of taxation arbitrary and non-comprehensive, and not only had the benefits to be taken into account, but there were also the effects on income creation of the expenditure of public authorities. A person might be much better off as a result of increased taxation than in the absence of that taxation. He would not object to paying 2s. in the £ for increased university education, and if he did not make more out of that tax than he paid he would be disappointed in himself.

There was no excuse for calculating levies on individuals and representing them as burdens collectively; Prof. Shirras arrived at the total burden and compared one country with another. What was the significance of the fact that 30 per cent. of the national income of Canada passed through the channel of the exchequer or the local authorities? What conclusion did Professor Shirras draw from the fact that the burden per head of the population in Canada was £45 and £40 in this country? What did that indicate? He said earlier that research should be directed to the answering of significant questions. What was the significance of this comparison? Did this mean that the Canadians were making a greater sacrifice than the British? What did it mean in peace-time? Was there any meaning even in war-time?

The speaker hoped that these calculations would not be put out by Professor Shirras in his next book without strict reservation. Were these figures to be used in discussions on the settlement of lend-lease transactions? Was it to be argued that because 32 per cent. of the Canadian national income went in taxation and only 30 per cent. in the United Kingdom, the Canadians had borne a greater sacrifice in this war? It was easy to raise the figure to any level desired. The Americans had only to raise the pay of their soldiers—which merely affected the distribution between the civilians and the soldiery—to increase the apparent burden imposed on the people of the United States.

He warned Professor Shirras that if he published such calculations they would be misused and would give rise to all sorts of misinterpretations, and even bad feeling, and he would bring upon himself very severe criticism.

DR. L. ROSTAS expressed his gratitude for the useful criticisms which were made in the course of the discussion. In his opinion there were two problems

which had to be considered: (1) What did the concept of the burden of taxation mean and how this burden could be *calculated*, (2) how this concept and the calculated data on the burden of taxation should be *interpreted*. Prof. Shirras and he were very clear from the beginning that the burden of taxation is a clear-cut concept: the amount (or the proportion of income) paid in taxation out of each of a range of different incomes. It differed from the concept of the burden of public finance, which Mr. George had in mind, namely what benefits—if any—do different social classes derive (or persons at different levels of income) from public finance, *i.e.*, taxation and public expenditure. The authors were careful in the course of their inquiry to point out at several junctures that their estimates relate solely to the burden placed on the citizen by the finances of the State; they take no notice of the advantage he derives. Before any judgments in equity are entered, both sides must be considered. This consideration however did not affect the usefulness of the concept of the burden of taxation. It was the necessary first step in approaching the burden of public finance. In the speaker's opinion, for a number of purposes—such as shaping future tax policy or finding out which classes contribute to benefits by public expenditure, etc.—the burden of taxation alone is of great interest; this is, however, a matter of interpretation, while in the course of their enquiry Prof. Shirras and the speaker were entirely concerned with the calculation of the burden.

In the course of the calculations they encountered a great number of difficulties. Income tax and surtax, which are graduated according to income, fitted in very well into their concept. Their main task was—as Mr. Hawtreys rightly pointed out—to try to allocate indirect taxes in the same way. In cases of some of the indirect taxes—imposed on commodities generally consumed, such as tea and sugar—the task was relatively easy. Great difficulties arose, however, with the duties on drinks and tobacco, partly because these commodities are not consumed generally or in equal extent by everybody, partly because variations in the consumption bear no or no direct relation to income. It was therefore not possible or advisable to calculate the burden on one representative consumer, as there are a number of representative consumers at each income level. Instead they tried to calculate the burden, on basis of evidence available, on a number of representative consumers, such as light, moderate and heavy consumers; they worked out the possible limits of the burden for a great number of cases, varying both the amount of consumption and also the kind and quality of drinks and tobacco, as both these variations are affecting the burden. This was brought out very clearly in his comments in to-day's discussion by Mr. Webb. At every stage they stated that the burden suggested is true only on certain assumptions.

Another problem with which the authors were much concerned was the scope of the taxes to be included in the burden. There were a number of disputable items, such as social insurance contributions of workers, mentioned in the discussion. In defining taxes they laid great stress on the compulsory element, and included social insurance contributions on that account. Those who are in favour of exclusion are stressing the insurance element, which is by now very weak. A very considerable body of economists would support the authors in treating social insurance contributions on workers as a tax, a procedure which was accepted by the Chancellor of Exchequer in his White Papers on National Income and Expenditure. In the case of employers' contributions there is, Dr. Rostas assumes, no difference of opinion that these should be treated as any other indirect tax. The authors regarded them as costs, which enter into prime costs and thus into prices, and are paid by the consumer, a procedure similar to that suggested by Mr. Hawtreys. Another disputable item was the burden of producers' subsidies and of protective duties. Their exclusion was indicated rather by practical difficulties of calculation and not by principal considerations. They made an exception in the case of sugar, as it was easy to calculate the burden of the subsidy; in fact it should have been difficult not to take it into account. But he agrees with Mr. Hawtreys that this is a disputable point.

To reply briefly to a few other points raised: post-war credits were treated as part of the tax burden, as is stated very clearly in the book. A table also showed the amount of post-war credits at each level of income. Post-war credits are treated in the same way by the Chancellor of Exchequer in his White Paper on National Income. Mr. George objected that for 1941-42 the burden is shown from £100 level upwards. This is necessary for reasons of comparison with previous years. The number of families at different levels of income or the fact that in 1941-42 very few families, fortunately, had as little as £100 income is entirely irrelevant for this type of calculation. Mr. George also suggested that the burden of duties on drinks and tobacco allocated to this group is too high. It is, however, the burden only on certain assumptions, and the authors made reference to the fact that the actual consumption at that income level is probably lower and also, therefore, the duty burden. With regard to the classification of families, it should be noted that the tax-paying family is really an artificial concept, as compared with the social family. It is, however, a useful concept. The authors calculated the burden for different-sized tax families in such detail that the burden of any chosen social family—or types of cases mentioned by Mr. Hawtrey—can be easily calculated.

MR. ROY SNELL said that when Professor Shirras's book appeared last November he read it. He did not profess to be a competent critic on this subject, and Dr. Hawtrey had said that some of the assumptions were guess-work, but he had been looking at the parts of the tables which referred to himself. He had been greatly fortified to find the percentages almost exactly right. He would therefore describe the guesses as extremely well-educated guesses. He was somewhat worried about the death-duties' assumption; there did not seem to be any constant ratio between the income and capital of an estate, also the income would vary if the capital was varying, and he would subscribe to Sir William Elderton's method of converting it to an annuity, if one had to find an annual equivalent.

With regard to indirect taxation, it was stated the consumption of things like tea, sugar, etc., were dependent on income available. In 1940-41 there was precise rationing of tea and sugar and restricted consumption of petrol, and he assumed that the authors had taken this into account, because otherwise the comparison with 1937-8 would not be parallel, and the inference would follow that those who could afford it were all in the black market for tea, sugar, etc.

A practical step in connection with the burden of taxation which appeared to him to be urgent was to tax earnings at the source by the deduction of some amount like 5s. or 6s. 8d. in the £, and to adjust at the end of the year by a balancing payment or refund. At the lower incomes this might well mean quite often a refund, and the psychological effect of this on an employee in a factory, for instance, who always spent pretty well all he received, would be very beneficial.

He thought it was a cause of considerable industrial discontent when employees were suddenly faced with relatively large amounts of deductions to be made in quite short periods. This was accentuated where much overtime and high incomes were earned during long hours of daylight, if the tax was not deducted at the time of payment, and had to be found during the winter of shorter daylight hours and much lower earnings. The United States proposal to jump one year and tax on current earnings seemed to him extremely desirable, and likely to be a big factor in industrial harmony. Deduction at the time from earnings is a more effective check on undesirable marginal luxury spending during peak periods of fluctuating incomes.

The following contributions were received in writing:

SIR GWILYM GIBBON: The following comments are designed to reinforce some criticisms and to add a few suggestions.

1. *Death Duties*.—Quite apart from the queer results obtained, surely these

attempts to convert the duties into annual equivalents, on the lines of income-tax payments, are misdirected applications of the statistician's zeal for simplicity of statement. There is no obligation to set aside such sums; on the contrary, the money can be spent on current expenditure, with lessened liabilities to the Exchequer so far as the fortune at death is reduced—a plausible instance of a bounty on indulgence. If it were the practice for persons of means to set aside annual sums, there might be something to be said for such attempts—though even then no more than “might.” But this is far from being the case, though insurance is common for other provisions at death. It is not possible to calculate these notional annual sums with any approach to facts. Even if that were possible, their inclusion would be misleading, the more that explanatory comments in the text are often not thoroughly read and, what in practice is more important, not reproduced when the figures are quoted. As Professor Shirras has said, death duties are in the nature of a capital levy, and their incidence and their pros and cons differ from those of income tax.

2. *Luxury (non-essential goods) Taxes.*—These contain a large element of the voluntary, especially if a modest consumption be allowed for the frailties even of the restrained. The taxes were something of the nature of a fine paid to the State for indulgence. It is especially so now, with rates and yields so high, and with taxes levied as much to discourage expenditure as to produce revenue. This voluntary element might advantageously be more stressed in considering “burden of taxation.”

3. *Social Services.*—It seemed to be generally agreed that the contributions of the insured should not be treated as taxation. This would be so even if the services were “Beveridged,” and contributions made universal. But it was stated that the contributions of employers could rightly be regarded as taxation. But are not these contributions more akin to expenditure required of employers for the health and safety of their workers than to taxation?

4. *Family Budgets.*—It is well known that publications about these budgets differ in value and need to be used with discrimination. This fact fortifies the suggestion that calculations should be made for assumed budgets, with the assumptions declared, published information being used as no more than a help in making each budget as typical as reasonably practicable for the particular class.

Professor Shirras has rendered a service by submitting his “methods” to the cross-examination of members of the Society. It is a practice that might be advantageously followed. It might materially reduce the nebulosities of statistics.

MR. J. E. ALLEN: Much to my regret, I cannot take part in the discussion after Prof. Shirras' paper, as I shall be in Yorkshire on the 22nd, so I send this memorandum.

1. I think that the advantages gained by the lower-income classes ought to be included, and balanced against the taxation paid by them. It might then be found that these classes got more out of the Treasury than they paid into it.

2. I do not agree that “all compulsory contributions to public funds” raised from the public are taxes. In particular the compulsory contributions to the social services are clearly investments, and good investments too, as is proved by the popular demand that the Beveridge Plan, with its largely increased contributions, shall be carried through without delay. Motor licence duties on cars are a tax, and a good tax (though they might be called a payment for the use of the roads), but lorry duties do not cover the damage done to the roads by heavy vehicles.

3. It is no longer certain that direct taxes stick where they fall. Income tax tends to be taken into account when calculating the salaries which must be paid for a given occupation; so the tax, or part of it, is in fact passed on to the employer, especially if the employer is a Government Department or a big commercial concern.

Indirect taxation, too, may be passed on; it is so in many cases openly,

e.g., when wages are changed with alterations in the cost-of-living index, and taxation has raised the index.

4. Estate duty is paid, as Lord Quickswood has pointed out, by the heir, not by the estate.

5. I should not allow anything for sugar duty—in fact, sugar is sold by the Government at less than half the market price: I would gladly give 50 shillings for 50 pounds of sugar. So sugar should be regarded as being *subsidized* rather than taxed.

Finally, I disagree entirely with Professor Shirras's tables giving the amount of taxation paid by various income-classes. There are now no families earning as little as £100 a year, very few earning as little as £150. Boys and girls of 15 or 16 are the only persons earning £2 or £3 a week. Hence the tables give a false idea of the amount of taxation paid by families among the wage-earning classes. If there is any man with a wife and two children who earns only £2 a week, he has no right to spend £15 on beer and tobacco.

What has happened since Viscount Samuel gave his presidential address is that wage-earners have moved up a class, perhaps more than one class, so that his £100-a-year man is now in the £200 class. I doubt if there are many working-class families who have not more money, often much more money, to spend now, after allowing for all war taxation, than they had in 1938–39.

I might add that much of the income tax which seems to be paid by the lower-income groups is only a compulsory non-interest-bearing *loan*. It will be given back, after the war, in Post-War Credits. The same thing applies to the 20 per cent. of E.P.T., although this is not to be paid out as dividends and will never become part of the shareholder's income.

A small point: no income tax between £80 and £110 (single person); then tax at 15s. in the £ on the next £23!

The CHAIRMAN did not think he had anything to say on his own account; they had had an interesting discussion which would be of considerable advantage to the authors of the paper.

The vote of thanks was carried by applause.

PROFESSOR SHIRRAS thanked the Fellows for the very useful discussion. The first volume of the *Journal* was issued in 1838 and he was quite certain that no more helpful discussion could be found in the volumes since that date. The discussion would prove invaluable when at some future date the burden of taxation came again to be measured. A good deal of discussion had arisen on the method followed in the calculation of the burden of death duties and all he would like to say was that no one method is perfect. The method adopted was not adopted rashly and full consideration was given to the method followed by the Colwyn Committee. To-day circumstances had changed and both he and his colleague, Dr. Rostas, with the Special Committee of the National Institute of Economic and Social Research, adopted the method outlined in the paper after the most careful examination of alternative methods. The whole enquiry was in his view a type of research which yields a rich harvest when it involves a definite answer to a definite question and when the question is one of fact. The largest contributions could always be products of individual scholarship and research as there was no substitute for firsthand knowledge of one's own materials. Nevertheless, group research had its uses and advantages. There were many important tasks which were beyond the powers and resources of the individual and called for the co-operation of men with different experience and different capacities. The advantages of team research were obvious. The disadvantages or rather limitations were equally obvious since they arose from the fact that research was more than a routine process. An old friend of his, the late Professor Allyn Young, put it thus: "The assembling and systematic ordering of historical documents and statistical data is not

enough. Willingness and industry are not enough. A perfected scientific technique is not enough. The really important thing is that research be directed towards the answering of significant questions, and it is hard to frame significant questions except in the light of definite hypotheses. Formulating questions and hypotheses is the first and most important task of the investigator." He ventured to quote this as it was the basis underlying the enquiry into the Burden of British Taxation discussed that afternoon. It was important that this view of group research should be heard, read, marked, learned and inwardly digested. The National Institute of Economic and Social Research was doing in this connection yeoman service. When one thought of the neglected fields of research, the great stores of unexplored materials awaiting patient examination and refining, he was appalled at the work even in the field of public finance still waiting to be done. He again paid tribute to all, including his colleague and other Fellows of the Society who took part in the discussion.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society:—

George Sydney Bishop.  
Charles William Carr, Captain, R.A.  
Joseph Edward Davison.  
Paul Eveleigh Grainger, B.Sc.  
Hugh Paterson Haddow.  
David Hart.

Aurel Eugen Lengyel.  
Baron Perry of Stock Harvard, K.B.E.,  
LL.D.  
Margaret Slack, M.Sc.  
Stefan Vajda.  
Antony Edward Worley.

## WHOLESALE PRICES IN 1942

BY THE EDITOR OF "THE STATIST"

(*The Statist's* Index Numbers in continuation of  
Mr. A. Sauerbeck's figures)

IN Table I below are set out the Sauerbeck-*Statist* annual index-numbers for each year from 1846 to 1942, Jevons' figures for 1810 and 1818, adjusted to Sauerbeck's standard, being also included. These index-numbers, based on averages for the period 1867-77, are calculated (with few exceptions) from the average of weekly quotations throughout each year for the forty-five commodities which they cover. Up to the end of 1912 they were calculated by the late Mr. Augustus Sauerbeck. Since that date they have been compiled by *The Statist*.

In 1940 there was an advance of 33 per cent. in the annual index for all commodities, but the increase recorded in 1941 was only 11 per cent. This slowing-down of the pace of the advance was confirmed by the experience for 1942, when the percentage rise in the annual index was 6 per cent. It is probable that price control has had much to do with this result. It is true that comparison is with figures which had already risen well above the pre-war level, but this is not necessarily a full explanation of the three-year experience. That is attested by reference to the figures compiled during the last war; then, an increase of 27 per cent. in 1915, the first full year of hostilities, was followed by advances of 28 per cent. in 1916 and 29 per cent. in 1917. At the close of 1942 the index was 68 per cent. above that for August, 1939, whereas at the end of 1941 an advance of 62 per cent. had been shown.

A month-by-month analysis of the 1942 figures shows that the experience followed a different pattern from that of 1941. In the earlier period the increase for January and February, as compared with the same months of 1940, was around 9 per cent., and after five months in which it was about 12 per cent. it settled down again to 9 per cent. for each of the last three months. The 9 per cent. rate of increase was continued into the opening month of 1942, but in February there was a sharp rise to 12 per cent. Then came a progressive decline to 3 per cent. for July, August and September, and a moderate advance to 5 per cent. for October and 4 per cent. for the remaining two months.

In the quarterly figures these changes are reflected in a diminishing rate of increase in the middle half of the year, with an 11 per cent. increase for the first quarter being followed by one of 9 per cent. in the second and 3 per cent. in the third. This trend was reversed in the fourth quarter, when there was a 4 per cent. rise. In the food group, however, there was no such fourth-quarter upturn, the quarterly record of increases here being 20, 19, 7 and 5 per cent. This is in contrast with the showing made by industrial materials, where the rate of increase recorded reductions from 6 per cent. in the first quarter to 2 per cent. in the second and 1 per cent. in the third, and then a rise to 4 per cent. in the fourth.

After the comparative equilibrium maintained in 1941 the animal foodstuffs index went forward during 1942, the figure for the fourth quarter, for instance, being 6 per cent. above that for the corresponding period of the earlier period. Against 65.2 in the third quarter of 1939 and 137.9 in the second quarter of

1941, the figure for vegetable food soared to 188 per cent. in the second quarter of 1942, but had fallen back to 156.6 by the fourth quarter of that year. Stability continued to be the feature in the minerals group in the first quarter, but thereafter there was a progressive increase. With textiles the fall which had set in during the fourth quarter of 1941 continued till the third quarter of 1942, but in the remaining quarter there was a sharp increase. Sundry materials were relatively stable during the year, but their level was consistently higher than in 1941. The general quarterly index fell in the third quarter, and a rise in the fourth quarter still left it below the second-quarter level.

TABLE I

THE STATIST'S *Annual Index Numbers (in continuation of Sauerbeck's figures)*  
(1867-77 = 100)

Year	Average No	Year	Average No	Year	Average No	Year	Average No.	Year	Average No
1942	151	1922	131	1902	69	1882	84	1862	101
'41	142	'21	155	'01	70	'81	85	'61	98
'40	128	'20	251	'00	75	'80	88	'60	99
'39	95	'19	206	1899	68	'79	83	'59	94
'38	91	'18	192	'98	64	'78	87	'58	91
'37	102	'17	175	'97	62	'77	94	'57	105
'36	89	'16	136	'96	61	'76	95	'56	101
'35	84	'15	108	'95	62	'75	96	'55	101
'34	82	'14	85	'94	63	'74	102	'54	102
'33	79	'13	85	'93	68	'73	111	'53	95
'32	80	'12	85	'92	68	'72	109	'52	78
'31	83	'11	80	'91	72	'71	100	'51	75
'30	97	'10	78	'90	72	'70	96	'50	77
'29	115	'09	74	'89	72	'69	98	'49	74
'28	120	'08	73	'88	70	'68	99	'48	78
'27	122	'07	80	'87	68	'67	100	'47	95
'26	126	'06	77	'86	69	'66	102	'46	89
'25	136	'05	72	'85	72	'65	101	'18	159*
'24	139	'04	70	'84	76	'64	105	'10	171*
'23	129	'03	69	'83	82	'63	103		

\* Jevons' numbers adjusted.

TABLE II

THE STATIST'S *Annual Index Numbers—ten-year averages (1867-77)*

1838-1847 = 93	1901- '10 = 73	1918-1927 = 159
'48- '57 = 89	'02- '11 = 74	'19- '28 = 152
'58- '67 = 99	'03- '12 = 76	'20- '29 = 142
'68- '77 = 100	'04- '13 = 77	'21- '30 = 127
'78- '87 = 79	'05- '14 = 79	'22- '31 = 120
'88- '97 = 67	'06- '15 = 82	'23- '32 = 115
'90- '99 = 66	'07- '16 = 88	'24- '33 = 110
'91-1900 = 66	'08- '17 = 98	'25- '34 = 104
'92- '01 = 66	'09- '18 = 110	'26- '35 = 99
'93- '02 = 66	'10- '19 = 123	'27- '36 = 95
'94- '03 = 66	'11- '20 = 146	'28- '37 = 93
'95- '04 = 67	'12- '21 = 148	'29- '38 = 90
'96- '05 = 68	'13- '22 = 153	'30- '39 = 88
'97- '06 = 70	'14- '23 = 157	'31- '40 = 91
'98- '07 = 71	'15- '24 = 162	'32- '41 = 97
'99- '08 = 72	'16- '25 = 165	'33- '42 = 104
1900- '09 = 73	'17- '26 = 164	



## Monthly Fluctuations of the Index Numbers\* of 45 Commodities, 1867-77 = 100

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1888	70.9	70.6	69.9	69.8	68.1	67.4	69.0	70.1	71.9	72.4	72.7	73.2	70
1898	62.8	63.4	63.0	65.5	66.4	64.7	64.3	64.0	63.9	63.6	63.9	63.8	64
1899	65.4	65.8	65.6	66.1	66.6	66.9	67.9	68.3	70.0	71.5	71.6	72.3	68
1900	74.0	75.1	75.7	75.6	75.5	75.7	76.2	76.0	75.5	74.7	73.9	73.4	75
'01	72.2	71.7	71.0	70.6	70.5	69.8	69.5	69.8	69.6	69.6	69.0	68.4	70
'02	68.8	68.9	69.2	69.7	70.9	70.4	70.0	69.5	69.3	68.8	68.6	69.1	69
'03	69.5	70.2	70.4	69.4	69.6	69.5	69.5	70.0	69.1	69.0	69.0	70.0	69
1904	70.4	70.8	70.8	70.5	69.9	69.4	69.9	70.4	70.7	71.0	71.2	70.9	70
'05	71.2	71.4	71.8	72.0	71.7	72.0	72.5	72.3	72.4	73.2	74.2	74.9	72
'06	75.2	75.0	75.7	76.5	77.0	76.9	76.4	76.7	77.5	78.5	78.6	79.7	77
'07	80.0	80.7	80.0	80.7	82.4	82.0	81.1	79.4	79.1	78.8	76.7	76.2	80
'08	76.0	74.5	74.1	73.8	73.6	72.9	73.1	72.2	72.5	72.2	72.2	72.3	73
1909	72.0	71.9	72.4	74.3	75.4	75.1	75.2	74.9	74.7	75.2	75.5	76.3	74
'10	77.1	78.1	79.1	78.5	78.2	76.9	78.1	78.2	77.6	77.2	77.8	77.9	78
'11	78.5	78.6	78.9	80.0	80.3	80.0	78.9	79.5	80.3	80.7	80.6	80.9	80
'12	81.8	82.9	84.4	85.0	85.3	85.5	86.5	85.9	86.7	85.8	85.3	86.4	85
'13	86.4	86.1	86.7	86.2	85.7	84.1	84.2	85.0	85.7	84.5	83.3	83.8	85
1914	83.5	83.8	82.8	82.3	82.3	81.2	82.4	87.9	89.3	89.8	88.8	91.6	85
'15	96.4	100.9	103.7	105.9	107.2	106.4	106.4	107.0	107.8	110.0	113.1	118.4	108
'16	123.6	127.0	130.4	134.2	135.4	131.0	130.5	134.5	134.4	141.5	150.8	154.3	136
'17	159.3	164.0	169.0	173.0	175.0	180.4	176.9	175.7	176.4	180.6	182.9	185.1	175
'18	186.2	187.3	188.0	189.8	191.1	192.3	192.9	195.9	197.1	197.8	195.3	196.0	192
1919	192.1	187.5	184.7	184.6	194.6	199.4	206.4	212.7	214.8	224.3	231.0	235.2	206
'20	245.3	260.4	261.8	266.1	260.0	255.7	254.6	253.5	248.7	239.9	223.8	207.2	251
'21	197.2	183.0	177.2	169.8	162.2	155.8	158.2	154.3	149.4	138.4	136.7	133.6	155
'22	132.5	132.2	133.3	134.8	135.5	135.6	134.0	129.6	127.9	130.1	130.6	129.1	131
'23	130.2	131.9	132.7	134.0	132.2	127.9	124.8	125.0	127.8	127.7	132.4	133.2	129
1924	137.2	138.8	137.0	136.8	136.4	136.3	138.4	138.0	141.3	146.1	145.5	147.7	139
'25	144.8	143.1	140.1	137.5	135.7	131.2	134.3	134.3	132.7	130.2	132.9	130.4	136
'26	129.3	127.9	126.1	125.5	125.7	124.9	126.0	127.0	128.0	131.0	130.8	123.9	126
'27	123.1	124.1	123.6	123.3	123.8	123.1	122.0	122.8	121.5	120.6	121.5	121.4	122
'28	120.9	121.1	123.6	125.6	126.2	122.6	120.3	118.0	116.8	116.8	117.9	117.9	120
1929	117.0	120.1	120.5	116.5	113.0	113.1	115.2	113.0	112.6	111.1	108.3	108.8	115
'30	106.6	104.8	103.0	101.5	98.8	95.8	94.4	92.2	90.8	90.4	88.6	86.9	97
'31	85.7	85.5	85.5	84.4	82.2	82.6	80.2	79.1	80.7	82.3	83.0	85.4	83
'32	84.7	86.7	84.1	82.5	80.2	77.0	78.9	80.7	80.4	77.8	77.9	77.7	80
'33	77.8	77.0	77.0	78.5	80.9	81.3	81.7	81.2	80.7	80.5	79.3	80.0	79
1934	82.5	82.5	82.2	81.0	81.1	80.7	82.4	83.4	82.1	81.1	81.0	82.8	82
'35	83.6	83.4	82.9	84.1	85.2	83.7	84.3	84.1	85.1	85.8	86.3	86.7	84
'36	87.1	87.1	86.7	86.2	85.6	84.8	87.1	89.0	90.4	91.7	94.5	98.9	89
'37	99.6	102.1	107.3	104.7	106.2	104.7	105.9	104.4	103.3	100.8	96.7	97.3	102
'38	96.5	96.4	94.2	93.5	91.4	91.4	91.1	88.6	88.6	88.8	87.4	89.1	91
1939	88.7	88.6	89.0	90.5	90.6	90.6	88.7	90.4	99.7	105.8	112.2	120.1	95
'40	124.1	124.5	123.4	126.0	128.0	130.0	129.5	131.5	131.6	131.8	132.7	134.5	128
'41	134.9	136.3	138.0	141.1	143.5	144.4	145.3	145.1	145.5	143.7	145.5	146.5	142
'42	148.6	153.4	153.5	154.5	156.6	154.4	150.0	149.4	149.7	150.4	151.3	152.2	151
'43	153.3	153.2	154.0	154.9	155.6	155.4	156.0	154.4	154.6	153.7	153.9	153.9	

\* The average of the twelve monthly figures of each year does not necessarily coincide with the annual figures, as the latter are calculated mostly from the average of 52 weekly quotations, while the former are based on end-of-the-month prices.

## Summary of Index Numbers. Groups of Articles, 1867-77 = 100

	Vegetable Food (Corn, etc.)	Animal Food (Meat, etc.)	Sugar, Coffee, and Tea	Total Food	Minerals	Taxes	Sundry Materials	Total Materials	Grand Total	Silver *	Wheat Harvest †	Average Price of Consols ‡	Average Bank of England Rate ‡
												£	Percent.
1873.....	106	109	106	107	141	103	106	114	111	97.4	80	92½	4.750
1896.....	53	73	59	62	63	54	63	80	61	50.5	112	110½	2.483
1911.....	70	90	61	75	93	76	81	83	80	40.4	110	79½	3.487
1916.....	133	152	86	130	158	129	136	140	136	50.4	97	58½	5.470
1917.....	177	192	113	169	172	192	174	179	175	65.8	102	54½	5.15
'18.....	168	207	130	174	192	222	202	206	192	76.4	111	56½	5.0
'19.....	179	213	147	185	220	228	219	222	206	85.3	98	54½	5.186
'20.....	227	263	198	234	295	262	244	264	251	76.1	96	47½	6.71
'21.....	143	218	83	158	181	140	145	153	155	48.1	118	47½	6.092
1922.....	107	184	82	130	142	134	124	132	131	51.6	105	56½	3.692
'23.....	98	162	101	122	155	140	117	134	129	49.4	105	57½	3.496
'24.....	119	158	105	130	158	170	120	146	139	50.7	107	56½	4.0
'25.....	118	162	89	128	154	165	119	143	136	52.5	114	56½	4.575
'26.....	108	150	88	119	154	133	114	131	126	47.1	99	54½	5.0
1927.....	108	138	83	114	141	131	118	129	122	42.8	109	54½	4.650
'28.....	107	142	78	114	123	136	117	124	120	44.0	109	55½	4.5
'29.....	99	146	72	110	126	122	111	119	115	40.2	114	54½	5.508
'30.....	77	142	54	96	112	84	97	97	97	29.0	99	56	3.4
'31.....	68	119	50	83	100	63	85	82	83	20.4	99	55½	3.975
1932.....	72	105	50	79	99	64	81	81	80	19.5	105	66½	3.017
'33.....	60	106	47	74	107	67	80	83	79	18.7	114	73½	2.0
'34.....	63	108	50	77	109	72	80	85	82	20.0	120	80½	2.0
'35.....	66	107	42	76	112	80	83	90	84	26.4	112	86½	2.0
'36.....	76	109	41	81	118	83	88½	94	89	18.5	100	85½	2.0
1937.....	93	117	49	93	142	93	101	110	102	18.4	99	76½	2.0
'38.....	81	111	43	84	136	75	87	96	91	17.6	122	74½	2.0
'39.....	74	115	47	83	137	93	90	103	95	17.1	112	66½	2.5
'40.....	112	141	58	111	167	147	120	141	128	17.1	—	72½	2.0
'41.....	140	142	65	125	181	161	133	155	142	18.0	—	79½	2.0
1942.....	170	148	66	140	184	161	143	160	151	18.1	—	82½	2.0
Average													
1904-13	68	91	53	73	95	74	76	81	77	44.1	106	82½	3.733
1890-99	61	80	63	68	71	56	66	64	66	55.8	103	103½	2.958
'78-87	79	95	76	84	73	71	81	76	79	82.1	97	99½	3.264
1818-27	109	90	151	111	128	105	106	112	111	98.0	—	—	3.692

\* Silver (see note on p. 257), parity of 1 gold to 15½ silver = 100.

† Wheat harvest in U.K. to 1895: 29 bushels = 100; from 1896: 30 bushels = 100.

‡ Average price of Consols and the average Bank of England rate of discount are actual figures, not index-numbers; Consols 3% to 1888, 2½% from 1889, 2½% from April, 1903.

THE STATIST'S *Index Numbers—monthly averages by groups*  
(1867-77 = 100)

	Vegetable Food	Animal Food	Sugar, Tea, and Coffee	Food-stuffs	Minerals	Textiles	Sundry Materials	Total Materials	All Com-modities
<b>1940</b>									
Jan. ...	106.2	142.7	57.3	109.4	158.1	142.9	114.1	134.8	124.1
Feb. ...	103.7	140.5	57.5	107.5	161.0	140.8	118.6	136.8	124.5
March ...	102.6	140.5	57.3	107.0	161.2	139.9	115.5	135.3	123.4
April ...	102.7	140.5	57.6	107.0	163.4	145.6	121.1	140.0	126.0
May ...	104.2	140.5	56.9	107.6	166.6	150.7	122.0	142.9	128.0
June ...	117.2	140.5	56.4	113.0	165.7	148.9	123.4	142.6	130.0
July ...	106.5	140.5	58.1	108.8	172.1	150.0	123.1	144.6	129.5
Aug. ...	122.5	140.5	57.8	115.5	170.9	147.5	121.9	142.7	131.5
Sept. ...	122.9	140.5	59.8	116.1	170.2	148.4	121.5	142.9	131.6
Oct. ...	124.6	140.5	59.9	116.8	171.1	150.6	119.1	142.8	131.8
Nov. ...	126.6	140.5	57.6	117.2	173.8	152.1	119.4	144.1	132.7
Dec. ...	131.3	140.5	59.0	119.5	175.5	152.9	121.0	145.5	134.5
<b>1941</b>									
Jan. ...	131.3	140.5	59.1	119.5	176.8	152.9	122.0	146.3	134.9
Feb. ...	130.4	140.5	62.0	119.7	179.2	152.5	125.9	148.4	136.3
March ...	127.7	142.8	64.6	120.0	181.0	159.0	126.2	151.1	138.0
April ...	135.4	142.8	65.0	123.3	180.9	159.7	132.8	154.1	141.1
May ...	138.4	142.8	65.6	124.7	181.5	161.5	138.7	157.2	143.5
June ...	140.0	142.8	65.3	125.3	181.1	163.7	140.2	158.4	144.4
July ...	143.3	142.8	64.4	126.5	182.3	164.5	140.2	159.0	145.3
Aug. ...	145.3	142.8	66.1	127.7	180.5	166.0	137.1	157.7	145.1
Sept. ...	146.5	142.8	65.7	128.1	180.3	166.2	138.2	158.2	145.5
Oct. ...	147.0	142.8	69.0	129.0	181.0	164.8	130.0	154.4	143.7
Nov. ...	150.9	142.8	69.0	130.7	181.6	162.9	135.2	156.2	145.5
Dec. ...	155.3	142.8	68.8	132.5	182.2	161.5	137.3	156.7	146.5
<b>1942</b>									
Jan. ...	163.3	142.8	68.9	135.9	181.5	161.5	140.7	158.0	148.6
Feb. ...	169.8	142.8	69.4	147.1	181.6	161.5	139.6	157.6	153.4
Mar. ...	185.8	147.3	69.5	147.1	181.8	160.4	141.5	158.1	153.5
April ...	187.6	147.3	69.4	147.9	182.4	160.4	144.1	159.4	154.5
May ...	190.0	147.3	69.7	149.0	183.1	160.4	150.3	162.2	156.6
June ...	188.3	147.3	69.6	148.2	181.1	160.4	144.0	159.0	154.4
July ...	159.0	147.3	70.2	136.0	184.7	159.0	144.8	160.0	150.0
Aug. ...	157.9	147.3	71.7	135.8	186.4	158.0	143.1	159.3	149.4
Sept. ...	158.3	147.3	72.2	136.1	186.1	158.0	144.3	159.9	149.7
Oct. ...	156.4	150.4	72.5	136.6	186.9	164.2	141.0	160.5	150.4
Nov. ...	156.6	151.5	70.5	136.6	187.0	164.7	144.1	162.0	151.3
Dec. ...	156.9	151.5	71.1	136.8	186.5	165.9	147.0	163.4	152.2
<b>1943</b>									
Jan. ...	158.5	155.7	73.3	139.5	187.8	165.5	147.1	163.8	153.3
Feb. ...	158.8	155.7	73.3	139.7	187.6	163.0	148.3	163.4	153.2
Mar. ...	160.0	155.7	71.9	139.9	188.5	163.3	149.8	164.3	154.0
April ...	160.3	155.7	72.9	140.2	187.9	164.3	152.4	165.6	154.9
May ...	159.9	155.7	73.0	140.1	188.7	165.3	154.5	167.0	155.6
June ...	159.4	155.7	73.5	140.0	188.4	165.6	153.5	166.6	155.4
July ...	163.3	155.7	73.8	141.7	187.6	163.9	154.9	166.5	156.0
Aug. ...	152.3	155.7	74.2	137.1	188.7	163.5	155.9	167.1	154.4
Sept. ...	152.7	155.7	74.3	137.3	188.2	162.8	157.1	167.2	154.6
Oct. ...	150.4	155.7	73.9	136.3	187.8	161.3	156.4	166.4	153.7
Nov. ...	149.6	155.7	74.7	136.1	187.5	160.6	158.2	166.8	153.9
Dec. ...	150.2	155.7	74.0	136.2	188.0	160.6	157.5	166.7	153.9

## Quarterly Movements of Prices \*

Summary of Index Numbers, 1867-77 = 100

Years	Quar- ters	Vege- table Food (Corn, etc.)	Animal Food (Meat, etc.)	Sugar, Coffee, and Tea	Total Food	Min- erals	Tex- tiles	Sund- ry Ma- te- rials	Total Ma- te- rials	Grand Total	Sil- ver †
1891	I	69.0	127.3	48.6	86.2	103.4	62.7	89.8	85.1	85.6	21.8
	II	69.5	123.3	48.8	85.0	98.6	61.4	85.6	81.7	80.1	21.3
	III	70.0	117.4	47.0	81.4	98.5	58.6	81.6	79.0	83.0	21.9
	IV	75.7	107.9	53.7	82.9	102.2	66.9	85.4	84.1	83.6	21.5
'92	I	80.7	109.2	52.2	83.2	101.1	67.5	87.8	85.2	85.2	21.0
	II	77.6	107.6	50.2	82.9	95.1	59.4	79.6	77.3	79.9	19.4
	III	68.2	105.3	49.6	77.9	100.6	65.9	80.7	81.5	80.0	19.4
	IV	64.2	98.2	48.4	73.4	101.2	64.5	80.2	81.0	77.8	18.4
'93	I	60.2	106.0	47.3	74.4	99.7	62.0	79.1	79.4	77.3	18.2
	II	59.1	108.4	47.4	74.8	109.7	63.7	79.8	84.2	80.2	20.0
	III	62.0	105.8	47.9	75.2	111.0	71.0	80.0	85.6	81.2	18.5
	IV	58.5	106.4	47.4	73.8	110.9	67.7	79.7	84.4	79.9	18.5
'94	I	59.4	110.1	53.0	76.7	111.7	73.6	79.9	86.5	82.4	19.1
	II	58.7	110.3	52.2	76.1	108.4	70.8	79.1	84.4	80.9	18.6
	III	71.0	109.5	48.0	80.4	108.5	70.7	78.7	84.3	82.6	19.7
	IV	66.7	107.3	44.8	77.0	109.7	70.9	79.6	85.0	81.6	22.1
'95	I	64.4	111.2	41.3	76.8	108.9	77.4	82.6	88.0	83.3	23.0
	II	67.1	107.9	42.3	76.9	112.3	79.4	82.8	89.8	84.3	29.3
	III	68.8	106.6	40.6	76.8	113.8	80.1	82.3	90.1	84.5	27.3
	IV	70.7	104.1	41.8	76.9	116.7	83.6	84.9	93.0	86.3	25.7
'96	I	72.1	104.6	41.2	77.6	116.1	84.6	86.4	93.8	87.0	18.2
	II	71.2	107.1	39.7	77.8	114.7	79.4	84.8	91.2	85.5	18.6
	III	75.3	112.6	39.1	81.5	116.7	80.5	90.0	94.2	88.8	18.6
	IV	85.8	110.7	42.6	85.9	129.6	88.2	93.8	101.7	95.0	18.9
'97	I	93.1	112.7	47.1	90.6	144.3	97.4	102.3	112.0	103.0	18.6
	II	94.3	121.0	49.6	94.7	143.5	99.9	102.9	112.8	105.2	18.7
	III	93.3	121.4	50.2	94.6	147.7	94.6	101.4	111.8	104.5	18.4
	IV	95.5	116.3	47.2	93.0	136.3	81.2	95.6	102.1	98.3	18.0
'98	I	92.3	116.4	43.1	90.8	134.8	77.8	92.4	99.3	95.7	18.5
	II	89.2	114.1	42.2	88.5	132.0	73.5	86.5	94.8	92.1	17.4
	III	78.0	107.4	42.9	81.4	135.9	73.9	85.0	95.3	89.4	17.3
	IV	68.8	105.8	43.3	77.1	140.6	74.3	85.1	96.7	88.4	17.4
'99	I	68.0	110.9	43.5	78.7	134.2	79.6	84.0	96.2	88.8	17.7
	II	66.7	112.9	46.9	79.6	134.4	85.7	85.3	98.7	90.6	17.3
	III	65.2	117.0	48.1	80.7	135.8	91.1	88.0	101.8	92.9	15.7
	IV	93.2	130.3	57.4	99.3	146.7	123.5	106.4	122.5	112.7	17.8
'40	I	104.2	141.2	57.4	108.0	160.1	141.2	116.1	135.6	124.0	16.3
	II	108.0	140.5	56.7	109.2	165.2	148.4	122.2	141.8	128.0	16.7
	III	117.3	140.5	58.6	113.5	171.1	148.6	122.2	143.4	130.9	17.6
	IV	127.5	140.5	58.8	117.8	173.5	151.9	119.8	144.1	133.0	17.9
'41	I	129.8	141.3	61.9	119.8	179.0	154.8	124.7	148.6	136.4	18.0
	II	137.9	142.8	65.3	124.4	181.2	161.6	137.2	156.6	143.0	18.0
	III	145.0	142.8	65.4	127.4	181.0	165.6	138.5	158.3	145.3	18.0
	IV	151.0	142.8	68.9	130.7	181.6	163.1	134.2	155.8	145.2	18.1
'42	I	179.6	144.3	69.3	143.4	181.6	161.1	140.6	157.9	151.8	18.1
	II	188.6	147.3	69.5	148.3	182.2	160.4	146.1	160.2	155.2	18.1
	III	158.4	147.3	71.4	136.0	185.8	158.3	144.1	159.7	149.7	18.1
	IV	156.6	151.1	71.4	136.7	186.8	164.9	145.0	162.0	151.3	18.1

\* The averages of the four quarterly figures to each year do not necessarily coincide with the annual averages, as the latter are based as far as possible on average weekly prices. See also the *Journal*, 1893, p. 221; 1896, p. 144; 1901, p. 90; and 1909, p. 70.

† Silver, parity of 1 gold to 15½ silver = 100.

### Construction of the Tabular Statements

The following table illustrates the method of construction of the index numbers. The index numbers here given are based on the average prices for the eleven years 1867-77. Take, for instance, the *Gazette* price of English wheat:—

		s.	d.	
Average, 1867-77	...	54	6	= 100, average point.
„ 1914	...	35	0	= 64, or 36 per cent. below the average point.
„ 1930	...	80	7	= 148, „ 48 „ above „ „
„ 1936	...	53	3	= 98, „ 2 „ below „ „

The individual index numbers, therefore, represent simple percentages of the average point.

The articles are grouped in six categories:—

	Index Nos.	1867-77 Total Numbers	Example for 1912	
			Total Numbers	Average
1. Vegetable food, corn, etc. (wheat flour, barley, oats, maize, potatoes, and rice) ...	8	800	1,361	170
2. Animal food (beef, mutton, pork, bacon, and butter) ...	7	700	1,035	148
3. Sugar, coffee, and tea ...	4	400	263	66
1-3. Food ...	19	1,900	2,659	140
4. Minerals (iron, copper, tin, lead, and coal)...	7	700	1,285	184
5. Textiles (cotton, flax, hemp, jute, wool, and silk) ...	8	800	1,292	161
6. Sundry materials (hides, leather, tallow, oils, soda, nitrate, indigo, and timber) ...	11	1,100	1,577	143
4-6. Materials ...	26	2,600	4,154	160
General Average ...	45	4,500	6,813	151

The general average is drawn from all forty-five descriptions, which are treated as of equal value, and is the simple arithmetic mean as shown above.

## Index of Silver Prices

The base of the index numbers given below is 60.84*d.* per standard oz. = 100, this being a parity of 1 fine oz. of gold to 15½ standard ozs. of silver.\*

	Price per oz. standard	Index number		Price per oz. standard	Index number
Average 1873 ...	<i>d.</i> 59½	= 97.4	Lowest Nov., 1902	<i>d.</i> 21½	= 35.6
" '90-99...	34	= 55.8	End Dec., 1906 ...	32½	= 53.1
" 1917-26...	40½	= 66.6	" Dec., '08 ...	23½	= 38.1
" 1893 ...	35½	= 58.6	" Dec., '12 ...	29	= 47.7
" '96 ...	30½	= 50.5	" Dec., '13 ...	26½	= 43.7
" 1909 ...	23½	= 38.9	" June, '14 ...	26	= 42.7
" '14 ...	25½	= 41.6	" Dec., '14 ...	22½	= 37.3
" '15 ...	23½	= 38.9	" Dec., '15 ...	26½	= 43.1
" '16 ...	31½	= 50.4	" Dec., '16 ...	36½	= 58.7
" '17 ...	40½	= 65.8	" Dec., '17 ...	43½	= 70.0
" '18 ...	47½	= 76.4	" Dec., '18 ...	48½	= 77.9
" '19 ...	57	= 85.3	" Dec., '19 ...	77½	= 98.3
" '20 ...	61½	= 76.1	" Dec., '20 ...	40½	= 49.2
" '21 ...	36½	= 48.1	" Dec., '21 ...	34½	= 40.3
" '22 ...	34½	= 51.6	" Dec., '22 ...	31½	= 49.6
" '23 ...	31½	= 49.4	" Dec., '23 ...	33½	= 49.0
" '24 ...	34	= 50.7	" Dec., '24 ...	31½	= 50.4
" '25 ...	32½	= 52.5	" Dec., '25 ...	31½	= 52.1
" '26 ...	28½	= 47.1	" Dec., '26 ...	25	= 41.1
" '27 ...	26½	= 42.8	" Dec., '27 ...	26½	= 43.6
" '28 ...	26½	= 44.0	" Dec., '28 ...	26½	= 43.3
" '29 ...	24½	= 40.2	" Dec., '29 ...	21½	= 35.2
" '30 ...	17½	= 29.0	" Dec., '30 ...	14½	= 23.7
" '31 ...	14½	= 20.4	" Dec., '31 ...	20½	= 21.6
" '32 ...	17½	= 19.5	" Dec., '32 ...	16½	= 17.2
" '33 ...	18½	= 18.7	" Dec., '33 ...	19½	= 19.5
" '34 ...	21½	= 20.0	" Dec., '34 ...	24½	= 22.6
" '35 ...	29	= 26.4	" Dec., '35 ...	22½	= 20.6
" '36 ...	20½	= 18.5	" Dec., '36 ...	21½	= 19.4
" '37 ...	20½	= 18.4	" Dec., '37 ...	19½	= 17.7
" '38 ...	19½	= 17.6	" Dec., '38 ...	20½	= 17.3
" '39 ...	20½	= 17.1	" Dec., '39 ...	22½	= 17.3
" '40 ...	22½	= 17.1	" Dec., '40 ...	23½	= 17.9
" '41 ...	23½	= 18.0	" Dec., '41 ...	23½	= 18.1
" '42 ...	23½	= 18.1	" Dec., '42 ...	23½	= 18.1

\* All the index numbers in the table from 1916 to 1925 inclusive and from 1931 to date are calculated on the basis of the gold prices of silver instead of the sterling prices, though the latter are the price quotations given in the table. In arriving at the index numbers for these dates the prices of gold are taken as follows. For 1916, 1917 and 1918 the price is taken as 86s. 9½*d.* per fine oz., derived from the "pegged" New York rate of \$4.76½ to the £. For 1919 the average price of gold is taken as 93s. 4½*d.*, this being the parity price with the U.S. dollar, the average New York exchange in that year being \$4.429. For the other dates the index numbers are based on the quotations in the London market for exportable gold. The quotation at the end of 1919 was 109s. 8½*d.* per fine oz. At the end of 1920, 1921, 1922, 1923 and 1924 the quotations per fine oz. were 116s. 1*d.*, 98s. 0*d.*, 88s. 11*d.*, 95s. 4*d.*, and 88s. 2*d.* respectively and the average quotations in these years were 112s. 11½*d.*, 107s. 0½*d.*, 93s. 4*d.*, 90s. 3*d.*, and 93s. 8½*d.* respectively, while the average price in 1925 was 85s. 5½*d.* The prices at the end of 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941 and 1942 were 121s. 11*d.*, 123s. 9*d.*, 126s. 6*d.*, 141s. 0*d.*, 141s. 2*d.*, 141s. 7*d.*, 139s. 6*d.*, 149s. 7½*d.*, 168s., 168s., and 168s. respectively, and the average prices in these years were 92s. 6½*d.*, 118s. 0½*d.*, 124s. 10½*d.*, 137s. 7½*d.*, 124s. 1½*d.*, 140s. 3½*d.*, 140s. 8½*d.*, 142s. 6½*d.*, 154s. 4*d.*, 168s., 168s. and 168s. respectively.

*World's Production of Silver (in millions of ounces)*

	United States	Mexico	Canada	Australia	Other Countries	Total
1904... ..	57.7	60.8	3.7	14.5	27.5	164.2
'05... ..	56.1	65.0	5.9	15.0	30.3	172.3
'06... ..	56.5	55.2	8.5	14.2	30.6	165.0
'07... ..	56.5	61.0	12.8	19.0	34.8	184.2
'08... ..	52.4	73.6	22.1	17.2	37.8	203.1
'09... ..	54.7	73.9	27.5	16.3	39.7	212.1
'10... ..	57.1	71.4	32.9	21.5	38.8	221.7
'11... ..	60.4	79.0	32.7	16.6	37.5	226.2
'12... ..	63.8	74.6	31.6	18.1	36.2	224.3
'13... ..	66.8	70.7	31.5	3.5	51.4	223.9
'14... ..	72.4	27.5	28.4	3.6	36.5	168.4
'15... ..	74.9	39.5	28.4	4.1	37.3	184.2
'16... ..	74.4	38.2	25.4	4.2	26.6	168.8
'17... ..	71.7	35.0	22.2	10.0	35.3	174.2
'18... ..	67.8	62.5	21.2	10.0	35.9	197.4
'19... ..	56.7	62.7	15.7	7.4	32.0	174.5
'20... ..	55.5	66.8	12.6	7.5	33.0	175.4
'21... ..	53.1	64.5	13.1	4.9	35.7	171.3
'22... ..	56.2	81.1	18.6	11.3	46.3	213.5
'23... ..	73.3	90.9	17.8	13.3	50.7	246.0
'24... ..	65.3	91.5	19.7	10.8	52.2	239.5
'25... ..	66.1	92.9	20.2	11.1	54.8	245.1
'26... ..	62.7	98.3	22.4	11.2	59.0	253.6
'27... ..	60.4	104.6	22.7	9.0	57.3	254.0
'28... ..	58.4	108.5	21.9	9.0	59.5	257.3
'29... ..	61.2	108.7	23.1	9.0	59.7	261.7
'30... ..	51.0	105.0	26.0	8.9	57.1	248.0
'31... ..	31.0	86.0	21.0	7.6	50.4	196.0
'32... ..	24.0	69.0	18.0	6.5	47.5	165.0
'33... ..	22.8	68.1	15.2	11.0	52.0	169.1
'34... ..	32.5	74.1	16.4	10.8	56.6	190.4
'35... ..	45.6	75.6	16.6	11.4	71.5	220.7
'36... ..	63.4	77.5	18.3	12.7	81.8	253.7
'37... ..	71.3	84.7	22.7	14.3	80.9	273.9
'38... ..	61.7	81.0	23.8	101.3		267.8
'39... ..	63.9	75.9	24.5	101.6		265.9
'40... ..	67.0	82.6	25.3	98.4		273.3
'41* ...	69.1	78.4	22.0	97.8		267.3
'42* ...	54.0	74.0	22.3	—		—

\* Provisional. (Estimate by Messrs. Samuel Montagu &amp; Co.)

(000's omitted)

Year	Value of output £			Year	Value of output £		
1851 ... ..	...	...	17,200	1897 ... ..	...	...	48,500
'52 ... ..	...	...	26,550	'98 ... ..	...	...	58,949
'53 ... ..	...	...	31,090	'99 ... ..	...	...	63,027
'54 ... ..	...	...	25,490	1900 ... ..	...	...	52,312
'55 ... ..	...	...	27,015	'01 ... ..	...	...	53,630
'56 ... ..	...	...	29,520	'02 ... ..	...	...	60,975
'57 ... ..	...	...	26,655	'03 ... ..	...	...	67,337
'58 ... ..	...	...	24,930	'04 ... ..	...	...	71,380
'59 ... ..	...	...	24,970	'05 ... ..	...	...	78,143
'60 ... ..	...	...	23,850	'06 ... ..	...	...	82,707
'61 ... ..	...	...	22,760	'07 ... ..	...	...	84,887
'62 ... ..	...	...	21,550	'08 ... ..	...	...	90,995
'63 ... ..	...	...	21,390	'09 ... ..	...	...	93,302
'64 ... ..	...	...	22,600	'10 ... ..	...	...	93,544
'65 ... ..	...	...	24,040	'11 ... ..	...	...	94,930
'66 ... ..	...	...	24,220	'12 ... ..	...	...	95,783
'67 ... ..	...	...	22,805	'13 ... ..	...	...	97,481
'68 ... ..	...	...	21,945	'14 ... ..	...	...	92,709
'69 ... ..	...	...	21,245	'15 ... ..	...	...	97,114
'70 ... ..	...	...	21,370	'16 ... ..	...	...	92,597
'71 ... ..	...	...	25,400	'17 ... ..	...	...	87,236
'72 ... ..	...	...	24,200	'18 ... ..	...	...	78,605
'73 ... ..	...	...	23,600	'19 ... ..	...	...	73,078
'74 ... ..	...	...	22,950	'20 ... ..	...	...	68,522
'75 ... ..	...	...	22,700	'21 ... ..	...	...	67,848
'76 ... ..	...	...	22,540	'22 ... ..	...	...	66,723
'77 ... ..	...	...	23,830	'23 ... ..	...	...	77,888
'78 ... ..	...	...	22,020	'24 ... ..	...	...	81,807
'79 ... ..	...	...	21,400	'25 ... ..	...	...	82,267
'80 ... ..	...	...	22,130	'26 ... ..	...	...	82,211
'81 ... ..	...	...	21,150	'27 ... ..	...	...	82,582
'82 ... ..	...	...	20,500	'28 ... ..	...	...	82,400
'83 ... ..	...	...	20,640	'29 ... ..	...	...	84,500
'84 ... ..	...	...	20,830	'30 ... ..	...	...	88,500
'85 ... ..	...	...	21,250	'31 ... ..	...	...	95,100
'86 ... ..	...	...	21,430	'32 ... ..	...	...	103,400
'87 ... ..	...	...	21,735	'33 ... ..	...	...	107,700
'88 ... ..	...	...	22,644	'34 ... ..	...	...	116,000
'89 ... ..	...	...	25,375	'35 ... ..	...	...	125,700
'90 ... ..	...	...	24,421	'36 ... ..	...	...	140,000
'91 ... ..	...	...	26,846	'37 ... ..	...	...	148,400
'92 ... ..	...	...	30,134	'38 ... ..	...	...	158,700
'93 ... ..	...	...	32,363	'39 ... ..	...	...	165,500
'94 ... ..	...	...	37,229	'40 (provisional)	...	...	172,100
'95 ... ..	...	...	40,843	'41 (provisional)	...	...	169,600
'96 ... ..	...	...	41,559	'42 (provisional)	...	...	153,000

*Gold.*—The table shows the world's annual gold production since 1851. Prior to 1911 the estimates are those of the Bureau of the U.S. Mint and other authorities. The estimates since 1926 are those of the Union Corporation, Limited. The value is taken throughout at £4.25 per fine oz.



## Average Prices of Commodities \*

No. of Article	0	1		2	3	4	5	6	7	8	1-8	9		10
		Wheat		Flour	Barley	Oats	Maize †	Potatoes	Rice	Vegetable Food	Beef †			
Year	Silver †	English Gazette	American	Town Made white (now "A.R.")	English Gazette	English Gazette	American Mixed	Good English	Rangoon Cargoes to Arrive	Total	Prime	Mil- dling		
	d. per oz.	s. and d. per qr.	s. and d. per qr.	s. per sack (280 lbs.)	s. and d. per qr.	s. and d. per qr.	s. per qr.	s. per ton	s. and d. per cwt.		d. per 8 lbs.	d. per 8 lbs.		
1873 ...	59½	58-8	63	51	40-5	25-5	30	160	9-6	—	65	56		
1922 ...	34½	47-10	52-11	45½	40-1	29-1	31½	130	14-10	—	88½	82		
'23 ...	31½	42-2	47 3	39½	33-8	26-8	36	101	14-10	—	79½	74½		
'24 ...	34	49-3	53-9	43½	46-0	27-2	39½	186	16-9	—	82½	76½		
'25 ...	32½	52-2	62-4	50½	42-0	27-2	38½	154	16-0	—	80	73½		
'26 ...	28½	53-3	58-9	49½	36-11	25-1	29½	127	16-3	—	74	67		
'27 ...	26½	49-3	58-3	44½	42-0	25-4	30½	136	15-11	—	70	62		
'28 ...	26½	44-8	50-10	40½	39-0	29-0	38½	133	15-0	—	74	66½		
'29 ...	24½	42-2	51-3	38½	35-5	24-7	36½	111	14-3	—	71	66		
'30 ...	17½	34-3	36-10	33½	28-3	17-2	23	93	13-0	—	73	68		
'31 ...	14½	24-0	25-1	22½	28-0	17-8	15½	146	9-8	—	67	61		
'32 ...	17½	25-0	27-5	24½	27-1	19-3	18½	152	9-8	—	65	59		
'33 ...	18½	22-10	25-7	23½	28-7	15-10	17½	86	7-9	—	61	52		
'34 ...	21½	20-2	28-0	23½	30-11	17-5	19½	97	7-8	—	58	52		
'35 ...	20	22-2	31-1	25½	28-7	18-0	17½	107	8-10	—	51	49		
'36 ...	20½	30-9	35-1	31½	20-5	17-8	19½	146	9-0	—	54	50		
'37 ...	20½	40-0	49-7	40½	30-0	23-11	26½	136	10-5	—	61	57		
'38 ...	19½	28-11	39-3	30½	36-4	21-2	28½	111	10-7	—	62	58		
'39 ...	20½	21-5	30-1	22½	31-7	19-3	26½	117	11-1	—	61	58		
'40 ...	22½	42-10	33-6	24½	64-10	37-2	39½	143	15-5	—	72	68		
'41 ...	23½	62-10	32-2	27½	85-8	40-10	43	164	23-8	—	72	68		
'42 ...	23½	68-6	36-9	35	165-5	42-0	43	134	26-0	—	76	68		
Average 1904-13	26½	31½	36	30	25½	18½	24½	78	7½	—	51	44½		
1890-99	34	28½	31½	27½	25½	17½	19½	72	6½	—	47	37½		
'78-87	50	40	43½	34½	31½	21	25	102	8	—	55½	46		
'67-77	58½	54½	56	46	39	26	32½	117	10	—	59	50		

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

1873	...	97-4	108	113	104	104	98	92	137	95	851	110	112
1922	...	51-6	88	95	100	103	112	96	111	148	853	150	161
'23	...	49-4	77	84	86	103	111	86	148	781	134	149	
'24	...	50-7	90	96	95	120	105	122	159	167	954	139	152
'25	...	52-5	96	111	109	108	105	119	132	160	940	136	147
'26	...	47-1	98	105	107	95	96	92	109	163	865	125	134
'27	...	42-8	90	104	98	108	97	95	116	159	867	119	124
'28	...	44-0	82	91	87	100	112	118	111	150	851	125	133
'29	...	40-2	77	91	84	91	95	112	95	143	788	120	132
'30	...	29-0	63	66	72	72	66	71	79	130	619	124	136
'31	...	20-4	44	45	50	71	68	48	125	93	544	114	122
'32	...	19-5	46	49	53	69	74	58	130	93	572	110	118
'33	...	18-7	42	46	52	73	61	53	74	78	479	103	104
'34	...	20-0	37	50	50	79	67	60	83	77	503	98	104
'35	...	26-4	41	56	56	73	72	53	91	88	530	92	98
'36	...	18-5	56	63	69	75	68	60	125	90	606	92	100
'37	...	18-4	73	89	88	100	92	82	116	105	745	103	114
'38	...	17-6	53	70	67	93	81	86	95	106	651	105	116
'39	...	17-1	39	54	48	81	74	82	100	111	589	103	116
'40	...	17-1	78	60	53	166	143	122	122	154	898	122	136
'41	...	18-0	115	57	60	220	157	132	140	236	1,117	122	136
'42	...	18-1	126	66	76	424	162	132	115	260	1,361	129	136

\* The annual prices are the average monthly or weekly quotations, except potatoes, which are the average weekly quotations during the eight months January to April and September to December.

† Not included in the general average.

‡ Meat (0-13), by the carcass, in the London Central Meat Market.

§ La Plata from 1924.

## Average Prices of Commodities—Contd.

No. of Articles	11	12	13	14	15	9-15	16A	16B	17	18A*	18B**	18
	Mutton		Pork	Bacon	Butter		Sugar			Coffee		
Year	Prime	Milk- dling	Taxco and Small, average	Water- ford	Fried- land, Flno to Finest	Animal Food Total	British West Indian Refining s. per cwt.	Beet, German, 88 p. c., L.O.B. s. per cwt.	Java, Floating Cargoes s. per cwt.	Ceylon Plan- tation, Low Mid- dling s. per cwt.	Rio, Good s. per cwt.	Mean of 18A and 18B
1873 ...	71	63	54	81	123	—	22½	25	28	100	86	—
1922 ...	125	121½	101	145½	202½	—	15	14½	15½	120½	74½	—
'23 ...	114½	107½	89	113½	186	—	25½	23½	24½	117½	55	—
'24 ...	111½	103½	70	106	211	—	23½	20½	21½	152½	85½	—
'25 ...	106½	98½	84½	128½	206½	—	16½	11½	12½	153½	98½	—
'26 ...	89	80½	98½	130	173	—	16½	11½	12½	154½	89½	—
'27 ...	86	79½	85	102½	178	—	16½	12½	13½	143½	71½	—
'28 ...	92½	87	77	101½	185½	—	13½	10½	11½	143½	81½	—
'29 ...	89½	83	91	116½	180½	—	11½	8½	8½	141½	74½	—
'30 ...	92	86	89	106½	140½	—	8½	5½	6½	106½	42½	—
'31 ...	79	73	65	83½	130	—	7½	5½	6½	101½	33½	—
'32 ...	63	55	54	77	126½	—	7½	5½	5½	105½	54½	—
'33 ...	69	63	60	81½	105½	—	7½	4½	5½	86½	42½	—
'34 ...	74	70	65	90½	79½	—	6½	4½	4½	87½	42½	—
'35 ...	75	70	62	89	92½	—	6½	3½	4½	87½	29½	—
'36 ...	73	68	65	93½	98½	—	6½	3½	4½	58½	30½	—
'37 ...	78	74	68	94	108½	—	7½	5½	6½	75½	36½	—
'38 ...	62	56	69	97½	114	—	7½	4½	5½	75	19½	—
'39 ...	68	64	70	97½	122	—	9½	6½	7½	73½	22½	—
'40 ...	85	76	96	114½	143	—	9½	—	8½	86½	28½	—
'41 ...	85	76	96	123½	142½	—	9½	—	8½	137½	30½	—
'42 ...	90	78	101	130	143½	—	9½	—	8½	130½	28½	—
Average	58½	51½	47½	67	113	—	10½	10½	12	75½	43½	—
1904-13	54½	41½	42½	59	100	—	11½	11½	13½	98	62	—
1890-99	64½	53	49	71	116	—	17	18	21½	78	52	—
'78-87	63	55	52	74	125	—	23	24	28½	87	64	—

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

1873 ...	113	114	104	100	98	760	101	98	115	134	125
1922 ...	199	221	191	196	162	1,286	62	54	140	116	128
'23 ...	182	196	171	154	140	1,135	104	87	135	86	111
'24 ...	177	188	135	143	169	1,103	93	75	175	133	154
'25 ...	169	180	162	174	165	1,133	60	43	176	154	165
'26 ...	141	146	190	176	138	1,050	60	44	178	139	159
'27 ...	136	145	163	138	142	987	62	47	165	112	139
'28 ...	146	158	148	137	149	996	51	40	165	127	146
'29 ...	142	151	175	157	144	1,021	42	31	182	117	140
'30 ...	146	155	171	143	117	992	31	22	123	66	95
'31 ...	125	133	125	113	104	836	29	23	120	53	87
'32 ...	100	100	104	104	101	737	27	20	121	85	103
'33 ...	110	114	115	110	84	740	25	18	100	66	83
'34 ...	117	127	125	122	64	757	22	16	100	67	84
'35 ...	119	127	119	120	74	740	21	17	78	46	62
'36 ...	116	124	131	127	79	763	21	17	67	48	58
'37 ...	124	135	125	127	86	820	28	23	87	57	72
'38 ...	98	102	133	131	92	777	24	19	86	31	59
'39 ...	108	116	135	132	98	808	32	26	85	35	60
'40 ...	135	138	185	165	114	985	42	29	99	44	72
'41 ...	135	138	185	167	114	997	42	29	158	47	102
'42 ...	143	142	194	176	115	1,035	42	29	150	45	98

\* Index numbers not included in general average.

† B. India good middling from 1908. § Raw Centrifugals, 96% Pol., from 1924. || Nominul.

† Nominul.

|| White Javas, C.L.F., from 1924.

## Average Prices of Commodities—Contd.

No. of Article }	19A*	19B* Tea	19B*	19	16-19	1-19	20A	20B Iron	21	22 Copper	23 Tin	
	Congrou, Common	Indian, Good Medium	Average Import Price	Mean of 19A and 19B	Sugar, Coffee, and Tea Total	Food Total	Scottish Pig	Oleum- land (Mil- dis- brough) Pig	Bars, Common	Stand- ard	English Tough Cake	Strait
Year	d. per lb.	d. per lb.	d. per lb.				s. and d. per ton	s. and d. per ton	per ton	£ per ton	£ per ton	£ per ton
1873 ...	12	—	16-67	—	—	—	117-3	—	12½	84	92	132
1922 ...	8½	13½	14-9	—	—	—	99-10	90-7	11½	63½	66½	162
'23 ...	11	17½	17-58	—	—	—	108-0	108-9	11½	65½	69½	206
'24 ...	9½	17½	19-0	—	—	—	96-8	88-2	12½	63½	67½	251
'25 ...	7½	14½	18-34	—	—	—	83-4	72-8	11½	61½	65½	267
'26 ...	7½	16½	18-82	—	—	—	87-2	87-6	11½	58½	63½	297½
'27 ...	6½	14½	18-58	—	—	—	80-5	73-0	11½	55½	60½	303½
'28 ...	6½	12½	16-84	—	—	—	69-9	65-9	9½	63½	66½	229½
'29 ...	6½	11½	16-11	—	—	—	74-0	70-3	9½	75½	78½	207½
'30 ...	5½	9½	15-12	—	—	—	76-0	67-0	9½	54½	58½	144½
'31 ...	4½	6½	13-29	—	—	—	71-0	58-6	10½	38½	39½	121½
'32 ...	4½	5½	10-75	—	—	—	68-2	58-6	10	31½	33½	140
'33 ...	6½	8½	11-87	—	—	—	66	62-3	9½	32½	34½	202½
'34 ...	8½	12	13-20	—	—	—	69-6	66-11	9½	30½	32½	232½
'35 ...	6½	10½	13-06	—	—	—	70-6	67-10	9½	32½	34½	230½
'36 ...	6½	11½	13-19	—	—	—	78-6	73-2	10½	37½	41½	207½
'37 ...	6½	13½	14-58	—	—	—	104-6	94-4	12½	54½	59½	246½
'38 ...	6½	11½	14-04	—	—	—	118-0	109	13½	41½	45½	193½
'39 ...	6½	11½	14-18	—	—	—	104-3	100-7	12½	44½	—	232½
'40 ...	—	—	15-33	—	—	—	114-10	116-4	14½	62	—	273½
'41 ...	—	—	15-13	—	—	—	123	128	15½	62	—	284½
'42 ...	—	—	16-25	—	—	—	123	128	15½	62	—	275
Average	7½	7½	8½	—	—	—	57½	51½	6½	67½	72	164½
1904-13	4½	7½	9½	—	—	—	47	41½	5½	50	53	81
1890-99	6½	—	12½	—	—	—	46	38	5½	55	60	89
'78-87	11½	—	17½	—	—	—	69	60	8½	75	81	105

Index Numbers (or Percentages) of Prices, the Average of 1887-77 being 100

Year	107	—	97	102	426	2,037	170	—	152	112	—	126
1873 ...	107	—	97	102	426	2,037	170	—	152	112	—	126
1922 ...	77	—	86	82	326	2,405	148	—	136	84	—	154
'23 ...	98	—	102	100	402	2,318	168	—	140	88	—	166
'24 ...	82	—	110	96	418	2,475	143	—	152	84	—	230
'25 ...	70	—	106	88	356	2,429	121	—	144	82	—	254
'26 ...	69	—	109	89	352	2,267	135	—	130	77	—	283
'27 ...	60	—	108	84	332	2,166	119	—	136	74	—	289
'28 ...	56	—	98	77	314	2,104	105	—	120	65	—	219
'29 ...	54	—	93	74	287	2,006	112	—	118	101	—	198
'30 ...	46	—	88	67	215	1,826	111	—	121	73	—	138
'31 ...	42	—	78	60	199	1,579	100	—	123	52	—	115
'32 ...	38	—	62	50	200	1,509	98	—	121	43	—	131
'33 ...	58	—	68	63	189	1,408	99	—	117	44	—	193
'34 ...	77	—	77	77	199	1,459	106	—	116	40	—	221
'35 ...	60	—	76	68	168	1,447	107	—	117	43	—	219
'36 ...	56	—	76	66	162	1,531	118	—	123	50	—	198
'37 ...	58	—	85	72	195	1,760	154	—	149	73	—	235
'38 ...	58	—	81	70	172	1,600	176	—	161	56	—	185
'39 ...	56	—	82	69	187	1,584	159	—	150	59	—	221
'40 ...	—	—	89	89	232	2,115	179	—	173	83	—	260
'41 ...	—	—	88	88	261	2,375	195	—	189	83	—	271
'42 ...	—	—	94	94	263	2,659	185	—	180	83	—	262

\* Index numbers not included in the general average. † Approximate. ‡ Nominal. § First 9 months only.

## Average Prices of Commodities—Contd.

No. of Article }	Year	24	25A	25B	26	20-26	27	28	29A	29B	30A	30B	31
		Lead	Coal		Average Export Price s. per ton	Minerals Total	Cotton		Flax		Hemp		Jute
		English Pig £ per ton	Wallsend Hutton in London \$ s. per ton	New-castle Steam s. per ton				Mid-ling American d. per lb.	Fair Dholarah    d. per lb.	Petro-grad ¶ £ per ton	Russian Average Import Price £ per ton	Manilla Fair Roping £ per ton.	Petro-grad Clean (a) £ per ton
1873 ...	23½	32	—	20-90	—	9	6 ½	47½	44	43	36	18	
1922 ...	25½	34½	24½	24-16	—	12-10	8	95	84½	33½	57½	30½	
'23 ...	28½	32½	28	25-13	—	15-25	10	83½	84½	33½	57	26	
'24 ...	35½	27½	22 ½	23-38	—	16-26	11-03	120	104½	44	81	31½	
'25 ...	37 ½	29½	16½	20-08	—	12-64	11-01	92½	120½	46½	80½	49 ½	
'26 ...	32½	**30 ½	**16 ½	18-59	—	9-40	7-75	65	72½	43	74½	43½	
'27 ...	25 ½	23 ½	14½	17-80	—	9-54	8-27	95½	74½	43½	66½	32½	
'28 ...	22 ½	21 ½	13½	15-67	—	10-92	8-66	98½	91½	37½	61	33½	
'29 ...	24 ½	23½	15½	16-13	—	10-26	7-73	76 ½	71 ½	37 ½	61	32	
'30 ...	19½	24½	14 ½	16-64	—	7-49	5-12	53½	60½	26½	48½	20	
'31 ...	14 ½	24½	13½	15-98	—	5-90	4-60	36	35½	18½	27½	15½	
'32 ...	13 ½	23½	13½	16-27	—	5-24	4-85	45½	42½	18½	36	16½	
'33 ...	13½	22½	13½	16-08	—	5-54	4-53	51½	48½	16½	37	14½	
'34 ...	12½	20½	14 ½	16-08	—	6-70	4-80	60½	50½	14½	42 ½	14 ½	
'35 ...	16	20½	14½	16-30	—	6-71	5-42	79½	72½	19½	43½	16½	
'36 ...	19½	23½	15½	16-98	—	6-71	5-12	63½	60½	28½	42½	17½	
'37 ...	24½	24½	20½	19-05	—	6-21	4-80	78½	70½	34½	38½	19½	
'38 ...	17 ½	25½	18½	21-32	—	4-93	3-67	66½	63½	21½	38½	17½	
'39 ...	17½	25½	—	21-12	—	5-95	4-41	90½	72½	22½	48½	26½	
'40 ...	26½	28 ½	—	27-23	—	8-10	6-26	177½	183½	26½	100½	27½	
'41 ...	26½	30½	—	32-22	—	9-14	7-65	200½	—	31½	126½	26½	
'42 ...	26½	32½	—	34-87	—	8-83	7-37	200½	201-6	33½	133½	24½	
Average 1904-13	15½	18½	11½	11½	—	6½	5	32½	36½	30½	31½	18½	
1890-99	12	17½	10½	10½	—	4½	3	27	27	26½	25	12½	
'78-87	14	16½	8½	9	—	6	4½	33	34	35½	26½	15	
'67-77	20½	22	12½	12½	—	9	6½	46	48	43	35	19	

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

1873 ...	117	145	—	167	989	100	92	97	101	95
1922 ...	123	156	—	193	994	134	118	191	116	162
'23 ...	139	147	—	201	1,083	169	148	179	116	137
'24 ...	175	125	—	187	1,105	181	163	239	160	167
'25 ...	183	135	—	161	1,080	140	163	227	174	261
'26 ...	157	138	—	149	1,078	104	115	147	151	231
'27 ...	125	105	—	142	990	106	123	181	141	172
'28 ...	109	97	—	125	860	121	128	203	130	178
'29 ...	117	106	—	129	881	114	114	157	126	168
'30 ...	95	113	—	133	784	83	76	121	96	105
'31 ...	71	112	—	127	700	66	68	76	58	84
'32 ...	65	106	—	130	694	58	72	93	70	85
'33 ...	65	103	—	129	750	62	67	106	68	78
'34 ...	61	92	—	129	765	74	71	119	73	74
'35 ...	78	92	—	130	786	74	80	161	80	89
'36 ...	95	105	—	136	825	74	76	133	91	93
'37 ...	121	111	—	152	995	69	71	158	93	104
'38 ...	83	117	—	171	949	55	54	139	77	93
'39 ...	85	115	—	169	958	66	65	174	91	140
'40 ...	129	127	—	218	1,160	90	93	383	163	146
'41 ...	129	141	—	258	1,266	101	113	416	202	139
'42 ...	129	148	—	279	1,285	98	109	427	200	130

† Approximate prices.

| Now No. 1 Oomra, Fine.

| †† Lightnings from 1931.

† Approximate.

† Livonian Z.K. from 1921.

(a) Russian Sirots Group 1, Sort 1 from 1881-83; Jugo-Slav Peasant from 1924

‡ Nominal.

§ Best Yorkshire house after 1910.

\*\* Average price January-April, 1926.

## Average Prices of Commodities—Contd.

No. of Article }	32A	32B	33	34	27-31	35A	35B	35C	36A	36B	37
	Wool			Silk	Textiles Total	Hides			Leather		Tallow
Year	Merino, Port Phillip, Average Fleeced d. per lb.	Merino, Adelaide, Average Greasy d. per lb.	English, Lincoln Half Hogs d. per lb.	Testile 1 s. per lb.		River Plate, Dry d. per lb.	River Plate, Salted d. per lb.	Average Import Price d. per lb.	Dressing Hides d. per lb.	Average Import Price d. per lb.	Town s. per cwt.
1873 ...	25	11½	24½	21½	—	11	8½	—	18½	—	44
1922 ...	39	17½	9½	28½	—	9½	8½	8-06	24½	36	34½
'23 ...	43½	20½	12	24½	—	9½	8½	8-23	23½	31½	36½
'24 ...	53½	25½	18½	23½	—	10½	8½	8-63	22½	33½	42½
'25 ...	41½	17½	17½	18½	—	11½	8½	9-87	23	33	42½
'26 ...	36½	16½	15	15½	—	10½	8	9-32	21½	35½	38½
'27 ...	38½	17½	15½	15½	—	12½	10½	9-85	22½	36½	33½
'28 ...	37	17½	17½	14	—	15½	11½	12-09	23½	37½	30½
'29 ...	35½	13½	10½	13½	—	10½	8½	10-80	19½	38½	36½
'30 ...	18½	8½	10½	10½	—	6½	6½	7-80	18½	33½	28½
'31 ...	14-7	7-1	8½	8½	—	5½	5½	6-12	17½	32½	19½
'32 ...	15-0	7-2	5½	8½	—	4½	4½	5-47	17½	28½	21½
'33 ...	19-9	9-3	5½	6½	—	5½	4½	5-65	17½	26½	19½
'34 ...	21½	10-4	7	5½	—	4½	4½	5-71	17½	25½	17½
'35 ...	20-1	9-5	7½	5½	—	5½	5½	5-61	17½	25½	24½
'36 ...	24-7	12-2	10½	5½	—	6½	6	6-47	17½	27½	23½
'37 ...	26-9	12-7	10-9	8½	—	8½	7½	8-62	18½	28½	23½
'38 ...	18-6	8-9	11-9	7½	—	6½	5½	6-35	14½	24½	17½
'39 ...	17-9	9-0	12-2	13½	—	6½	6½	6-39	18½	23½	16½
'40 ...	27-7	13-2	18-6	17½	—	8	8½	8-50	25½	23½	22½
'41 ...	30-8	14-3	20-5	15½	—	7½	8½	8-45	24½	24½	22½
'42 ...	30-8	14-3	20-5	16½	—	8½	9	9-25	26½	26½	24½
Average 1904-13	17½	9	10½	11½	—	9½	7½	6½	16	17	31½
1890-99	13½	6½	10	11½	—	6½	5½	5	13½	13½	25
'73-87	18½	8½	11½	15	—	8½	6½	6½	15	17	35½
'67-77	21½	19½	23	19½	—	9	7	6½	16	18½	45

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

	118	—	124	95	822	120	—	—	114	—	97
1873 ...	118	—	124	95	822	120	—	—	114	—	97
1922 ...	180	49	125	1,075	—	114	—	—	174	—	77
'23 ...	206	61	105	1,121	—	113	—	—	158	—	81
'24 ...	254	96	102	1,362	—	119	—	—	163	—	94
'25 ...	188	87	79	1,319	—	132	—	—	161	—	94
'26 ...	170	76	69	1,063	—	121	—	—	164	—	85
'27 ...	177	78	67	1,045	—	142	—	—	172	—	75
'28 ...	174	91	61	1,086	—	172	—	—	176	—	83
'29 ...	156	81	60	976	—	120	—	—	166	—	81
'30 ...	86	54	48	669	—	92	—	—	150	—	64
'31 ...	70	43	39	504	—	77	—	—	146	—	43
'32 ...	71	29	35	513	—	66	—	—	132	—	47
'33 ...	94	30	29	534	—	68	—	—	127	—	44
'34 ...	102	35	24	572	—	67	—	—	123	—	39
'35 ...	96	37	24	641	—	69	—	—	125	—	55
'36 ...	119	53	25	646	—	82	—	—	129	—	52
'37 ...	127	86	37	745	—	109	—	—	134	—	52
'38 ...	88	60	35	601	—	81	—	—	110	—	39
'39 ...	86	62	57	741	—	84	—	—	119	—	36
'40 ...	131	94	76	1,176	—	109	—	—	141	—	49
'41 ...	145	104	68	1,288	—	107	—	—	135	—	50
'42 ...	145	104	70	1,292	—	116	—	—	150	—	54

\* Port Philip fleece washed nominal since 1895, exactly in proportion with the value of clean wool.

† Common New Style from 1921 to 1936. China, Extra "A" from 1937.

↓ Nominal.

## Average Prices of Commodities—Contd.

No. of Article	38		39	40A	40B	41	42	43	44	45A	45B	35-45	20-45	1-45
	Oil				Seeds	Petro- leum *	Soda			Timber		Stimuly Materials		
Year	Palm	Olive	Lin- seed	Lin- seed	Ro- ined		Crystals	Nitrate of Soda	Bengal, Good Con- suming	Howa, Average Import Price.	Sawn or Split, Average Import Price	Total	Total	Grand Total
	£ per ton	£ per ton	£ per ton	s. per qr.	d. per gall.		s. per ton	s. per cwt.	s. per lb.	s. per load	s. per load			
1873 ...	38	43	32	62	15½	100	15½	6½	65	62	—	—	—	—
1922 ...	34½	75½	39½	75½	15½	123	14½	9½	46½	117½	—	—	—	—
'23 ...	36½	66½	42½	77½	13	103	13½	7½	48	131½	—	—	—	—
'24 ...	40½	79½	42½	81½	13½	101½	13½	6½	49½	122	—	—	—	—
'25 ...	40½	73½	43½	80½	13½	100	13½	5½	47½	122½	—	—	—	—
'26 ...	37½	79½	32½	63½	13	100	13½	5½	48½	107	—	—	—	—
'27 ...	34½	102½	31½	64½	13	100	12½	5½	45½	107½	—	—	—	—
'28 ...	35½	80½	29½	66½	11½	100	10½	5½	45½	111½	—	—	—	—
'29 ...	34½	72½	35½	74½	12½	100	10½	5½	44½	107½	—	—	—	—
'30 ...	25½	62½	36½	61½	12½	100	9½	5½	44½	102½	—	—	—	—
'31 ...	19½	53½	18½	38½	11½	100	9½	5½	37½	83½	—	—	—	—
'32 ...	17½	57½	17½	38½	10½	100	8½	5½	35½	75½	—	—	—	—
'33 ...	15½	53½	20½	39½	10½	100	8½	5½	31½	75½	—	—	—	—
'34 ...	13½	62½	21½	42½	10½	100	7½	5½	31½	79½	—	—	—	—
'35 ...	19½	61½	24½	43½	10½	100	7½	5½	32½	73½	—	—	—	—
'36 ...	19½	70½	28½	48½	10½	100	7½	5½	37½	78½	—	—	—	—
'37 ...	22½	95½	31½	54½	10½	100	7½	5½	58½	103½	—	—	—	—
'38 ...	14½	68½	26½	46½	10½	100	8	5½	61½	94½	—	—	—	—
'39 ...	14½	73½	29½	49½	11½	100	8½	5½	57½	107½	—	—	—	—
'40 ...	19	114½	44½	66½	14½	100	9½	5½	106½	169½	—	—	—	—
'41 ...	20½	118	41½	70½	15½	100	13½	5½	191½	214½	—	—	—	—
'42 ...	23	118	44½	78½	16	100	13½	5½	235½	236½	—	—	—	—
Average	31½	43½	26½	49½	6½	60	10½	3	38	56	—	—	—	—
1904-13	24½	35	19½	38	5½	53	8½	4½	40	45	—	—	—	—
'78-87	32½	40	23	46	6½	62	12½	6	47	47	—	—	—	—
'67-77	39	50	30	60	12½	92	14	7½	60	54	—	—	—	—

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

1873 ...	97	86	258	122	109	110	92	111	1,163	2,974	5,011
1922 ...	89	151	127	122	134	102	128	143	1,361	3,430	5,895
'23 ...	93	133	134	104	112	96	103	157	1,284	3,488	5,806
'24 ...	103	160	138	105	111	97	84	151	1,325	3,792	6,267
'25 ...	104	147	137	105	109	96	79	150	1,314	3,713	6,142
'26 ...	96	159	106	104	109	95	78	137	1,254	3,395	5,662
'27 ...	88	205	107	104	109	90	76	134	1,302	3,337	5,503
'28 ...	92	161	108	94	109	78	76	138	1,286	3,232	5,396
'29 ...	89	144	122	102	109	73	76	134	1,225	3,082	5,178
'30 ...	65	104	110	102	109	70	76	129	1,071	2,524	4,350
'31 ...	51	108	63	90	109	65	76	106	934	2,138	3,717
'32 ...	45	114	61	84	109	62	76	97	893	2,100	3,609
'33 ...	40	108	67	82	109	60	76	94	875	2,159	3,567
'34 ...	35	124	71	80	109	56	76	97	877	2,214	3,673
'35 ...	50	123	75	84	109	54	76	92	912	2,339	3,786
'36 ...	51	140	85	81	109	54	79	102	964	2,453	3,984
'37 ...	58	192	95	86	109	56	79	142	1,112	2,852	4,612
'38 ...	38	137	81	87	109	57	79	136	954	2,504	4,104
'39 ...	37	148	88	88	109	58	79	145	991	2,690	4,274
'40 ...	49	228	122	117	109	70	79	243	1,316	3,661	5,776
'41 ...	53	236	124	124	109	93	79	356	1,466	4,020	6,395
'42 ...	59	236	137	128	109	96	79	413	1,577	4,154	6,813

\* Petroleum average, 1873-77.

† Nominal.

## MISCELLANEA

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## ON A THEOREM CONCERNING SAMPLING

By HAROLD SIMPSON

SUPPOSE that from a very large univariate population with normal (Gaussian) distribution we select at random  $i$  samples containing respectively  $n_1, n_2, \dots, n_i$  individuals. Let  $m_1, m_2, \dots, m_i$  be the arithmetic means of the samples and  $s_1^2, s_2^2, \dots, s_i^2$  their variances measured from these means. Let  $a_1, a_2, \dots, a_i$  be any constants such that

$$(a_1^2/n_1) + (a_2^2/n_2) + \dots + (a_i^2/n_i) = 1 \quad \dots \quad (i)$$

We shall show that, if the drawing of the samples is repeated very often, then the number of times in which the numerical value of

$$\frac{a_1 m_1 + a_2 m_2 + \dots + a_i m_i}{\sqrt{(n_1 s_1^2 + n_2 s_2^2 + \dots + n_i s_i^2)}} \quad \dots \quad (ii)$$

exceeds  $\tan \alpha$  ( $0 \leq \alpha \leq \frac{1}{2}\pi$ ), divided by the whole number of drawings, has the value

$$\int_{\alpha}^{\frac{1}{2}\pi} \cos^{i-1} \theta \, d\theta / \int_0^{\frac{1}{2}\pi} \cos^{i-1} \theta \, d\theta; \quad i = n_1 + n_2 + \dots + n_i - i \quad \dots \quad (iii)$$

Though it is not absolutely necessary, we shall suppose that

$$a_1 + a_2 + \dots + a_i = 0, \quad \dots \quad (iv)$$

for then (ii) is independent of the position of the mean of the population as well as of its variance, both of which in practice may be unknown.

The theorem is an extension of the well known case in which  $i = 2$ , given, for example, in G. U. Yule and M. G. Kendall's "Theory of Statistics" (Griffin & Co., 1937), p. 422. It will test the validity of our fundamental assumptions that the samples were truly random and all drawn from the same normal population. If in our actual observations the ratio (iii) is unduly small, e.g.  $< 0.5$  according to a common convention, doubt will be cast on our assumptions, though we cannot conclude that they are certainly incorrect.

The value of the ratio (iii) is given in the tables, for instance, in K. Pearson's "Tables of the Incomplete Beta-function" (Biometrika Office, 1934), being the function  $1 - I_x(p, q)$  of those tables with  $x = \tan \alpha$ ,  $p = \frac{1}{2}i$ ,  $q = \frac{1}{2}$ .

In order that we may feel secure about our assumptions, this ratio must be greater than 0.5 whatever values  $a_1, a_2, \dots, a_i$  may have subject to (i) and (iv). The ratio is least when  $\alpha$  is greatest, which is the case when  $a_1, a_2, \dots, a_i$  are chosen to make

$$a_1 m_1 + a_2 m_2 + \dots + a_i m_i$$

have its numerically greatest value subject to (i) and (iv). The method of

"undetermined multipliers" readily shows that for this purpose we must take

$$a_1 = n_1 b_1 / \sqrt{(n_1 b_1^2 + n_2 b_2^2 + \dots + n_i b_i^2)}, \text{ etc.,}$$

where

$$b_1 = (n_1 + n_2 + \dots + n_i) m_1 - (n_1 m_1 + n_2 m_2 + \dots + n_i m_i), \text{ etc.}$$

To prove the theorem let the normal distribution of the population be

$$(h/\sqrt{\pi}) \exp(-h^2 x^2).$$

Let the  $t + i$  values of the variate  $x$  in all the samples be  $x_1, x_2, x_3, \dots$ . Then the ratio of the number of drawings in which (ii) exceeds  $\tan \alpha$  numerically to the total number of drawings is the ratio of the value of

$$\iint \dots \int \exp\{-h^2(x_1^2 + x_2^2 + \dots + x_{t+i}^2)\} dx_1 dx_2 \dots dx_{t+i} \quad (v)$$

when  $x_1, x_2, \dots$  are subject to the restriction that (ii) is numerically greater than  $\tan \alpha$  to its value when  $x_1, x_2, \dots$  are unrestricted.

Suppose that  $x_1, x_2, \dots, x_{n_1}$  are the values of  $x$  in the first sample. Change them by an orthogonal transformation into new variables  $\xi_1, \dots, \xi_{n_1-1}, p_1$ , where  $p_1 = \sqrt{n_1} m_1$ . Then

$$n_1 s_1^2 = x_1^2 + x_2^2 + \dots + x_{n_1}^2 - n_1 m_1^2 = \xi_1^2 + \xi_2^2 + \dots + \xi_{n_1-1}^2.$$

If we treat the other samples similarly, the integral (v) becomes

$$\int \dots \iint \dots \int \exp\{-h^2(p_1^2 + p_2^2 + \dots + p_i^2 + \xi_1^2 + \xi_2^2 + \dots + \xi_i^2)\} dp_1 \dots dp_i d\xi_1 \dots d\xi_i.$$

Transform  $p_1, p_2, \dots, p_i$  by an orthogonal transformation into new variables  $q_1, q_2, \dots, q_{i-1}, q$  such that

$$q = (a_1 p_1 / \sqrt{n_1}) + (a_2 p_2 / \sqrt{n_2}) + \dots + (a_i p_i / \sqrt{n_i}),$$

which is lawful on account of (i). Also transform the variables  $\xi_1, \xi_2, \dots, \xi_i$  into "polar co-ordinates" by the transformation

$$\xi_1 = r \cos \theta_1, \xi_2 = r \sin \theta_1 \cos \theta_2, \xi_3 = r \sin \theta_1 \sin \theta_2 \cos \theta_3, \dots, \\ \xi_i = r \sin \theta_1 \sin \theta_2 \dots \sin \theta_{i-1}.$$

Then integrate with respect to  $q_1, q_2, \dots, q_{i-1}, \theta_1, \theta_2, \dots, \theta_{i-1}$  and the ratio of the two values of the integral (v) becomes the ratio of the value of

$$\iint r^{i-1} \exp\{-h^2(r^2 + q^2)\} dq dr$$

when  $|q/r| > \tan \alpha$  to its value when  $|q/r|$  is unrestricted.

Putting  $r = \rho \cos \theta, q = \rho \sin \theta$  and integrating with respect to  $\theta$  we have the theorem.



THE PRICE OF PROVISIONS AND SOME SOCIAL CONSEQUENCES IN WORCESTERSHIRE  
IN THE EIGHTEENTH AND NINETEENTH CENTURIES

By FRED WOODCOCK

THE most striking feature of price movements during the period under review is the violent fluctuations which occurred, not over a long period, but in many instances from month to month.

The following prices of wheat in Worcester market demonstrate the rapid fluctuations and the increases during the famine years of 1756-1757:

Year					Price per bushel			
					s.	d.	s.	d.
1756.	July	...	...	...	5	10	to	6 (0)?
	September	...	...	...	4	10	"	6 0
	November	...	...	...	5	6	"	7 4
	December	...	...	...			"	7 8
1757.	January	...	...	...	7	10	"	9 0
	February	...	...	...	7	0	"	9 2
	April	...	...	...			"	9 8 *
	May	...	...	...				7 6

\* This was the price quoted, but not generally divulged as farmers were said to be refusing 10s.

During the later part of the eighteenth century, at least, we must not assume that a fall in the price of wheat necessarily led to a corresponding decrease in the price of bread; this phenomenon gave rise to the following comment in Berrow's *Worcester Journal*, October 13th, 1791:

"The average price of wheat has again fallen in London, the last return being 10d. per quarter less than the preceding. Total average for England and Wales, per bushel 5s. 5½d., per quarter £2 3s. 8d., making a fall in the last three months, of five shillings and four pence; during which time bread has fallen one assize. Have not the publick a right to an explanation of this inconsistency?"

The fluctuation in the weight of bread (as fixed by the Mayor and Justices) gives a more accurate indication of the variation in price, for a decrease in the weight of bread (to be sold at a fixed price) is tantamount to an increase in price, and vice versa.

We give (on page 269) the weight of the penny loaf in as much detail as possible, so as to show the month by month variations.

In 1787 the weight of the penny loaf was such, that the city magistrates resolved not to fix an assize in the future. This decision had to be revised, however, in 1790, for the price of wheat was so high that intervention was necessary.

If the following case is an indication of the general position, we may assume that the weights, as fixed by the magistrates, were not always adhered to, and that the bread when sold was often deficient in weight.

"On Monday last a country Baker was convicted before the Mayor and Justices, for selling a six penny loaf of standard Wheaten Bread, deficient in

Worcester Assize of Bread			
Weight of Penny Loaf			
Year		White	Household
		oz. dr.	oz. dr.
1725.	October ...	6 10	8 1
'33.	December ...	10 5	15 7
'36.	May ...	8 1	12 1
'41.	January ...	5 5	7 15
	February ...	5 7	8 3
	August ...	8 13	13 4
'51.	November ...	7 12	11 9
'56.	November ...	5 10	8 7
'58.	November ...	- - *	12 1
	December ...		12 2
'59.	February ...		11 9
'61.	? ...		15 4
'65.	? ...		8 7
'67.	July ...		6 9
'75.	November ...		13 4
'78.	May ...		10 15
'79.	April ...		15 7
'90.	? ...		8 11
'92.	? ...		12 1
'93.	January ...		10 5
	February ...		9 15
	September ...		11 2
	December ...		9 0

Wheat			
Lowest Highest			
		oz. dr.	oz. dr.
1794	...	8 7	- -
'95	...	6 15	7 15
'96	...	4 11	8 11
'97	...	8 3	9 9
'98	...	9 0	10 11
'99	...	7 8	9 15

\* In 1758 in regulations made for the sale of the penny loaf the white loaf disappeared.

weight two ounces, and fined two shillings, agreeable to the Statute of the 31st. Geo. 2d." (Borrow's *Worcester Journal*, March 18th, 1790.)

The distress which was rife in 1756-57 led to the following disturbances in Worcestershire.

In November 1756 several barges of wheat, etc., were raided while coming up the Severn, and several thousands of bushels of grain were carried away. Conditions were so bad that in April 1757, 5,000 bushels of wheat which arrived in Worcester were sold to the poor at 7s. 6d. per bushel, 2s. less than the locally current price. At Worcester market in May many bags were cut and the wheat stolen; a wagon travelling to Kidderminster was stopped by a crowd of women, who filled their aprons and bags with wheat. In the same month

lively scenes were witnessed at Bewdley market, where a large number of women cut open bags of wheat and insisted upon it being sold at 7s. a bushel, the same price as at the last Kidderminster market; the town authorities met the situation by selling foreign wheat at the public granary at 7s. 6d. per bushel. A mob held-up a wagon-load of wheat sold to a person in Droitwich at 9s. a bushel and forced the wagoner to sell it at 5s. a bushel.

It was not only the high price of bread which caused dissatisfaction among the labouring classes. For we find that at Worcester in September 1766 the farmers demanded 8d. to 9d. per lb. for butter (usual price 6d. per lb.), but the potential buyers "seized the baskets and wantonly threw them into the air." Owing to the very severe weather, the price of butter rose from 2s. to 2s. 6d. per lb. in January 1766, but eventually dropped to 9d.

The price of cheeses at the Worcester Fair varied as follows:

Year	Price per Cwt.		Year	Price per Cwt.	
	Bests	Seconds		Bests	Seconds
1760 ... ..	24-28	21-24	1792 ... ..	36-40	30-34
'90 ... ..	38-42	32-35	'93 ... ..	39-45	32-36
'91 ... ..	38-44	30-36	'93 ... ..	40-43	34-36 *

\* At Ledbury.

Prices quoted for other foodstuffs—not necessarily in the same part of the county in every instance—were:

Year	Price per lb.			Milk
	Beef	Beef and Mutton	Mutton	
1775 ... ..	d.	d.	d.	1d. per quart.
'83 ... ..	3½-4	—	4	
'91 ... ..	3½			
'93 ... ..	2½-3½		3½-5	
'94 ... ..	3½-4 *	3-4	4½	
'95 ... ..		3½-5		

\* "Those parts which are more particularly called for by the labouring part of the inhabitants."

Commenting on the Price of Provisions in 1794, W. T. Pomeroy (*General View of the Agriculture of the County of Worcester*) has this to say:

"Provisions of all kinds are more than doubled in price within the last forty years; and the same causes which have produced this rise, still continuing, there is little prospect of their becoming cheaper. A very principal one, is the increase of manufactories in this, and the adjoining counties. . . . A second, and perhaps of equal consequence, is the encroachment luxury has made on the mode of living of the inhabitants in general, from which the farmer is not exempted."

So far as can be ascertained from the reports in the local newspaper of the time, there were not many occasions when the provisions offered for sale in the local market were found to be deficient in weight. This, we learn, cannot be said to be general throughout the country. We do find evidence, however, that Worcestershire was no exception to the practice of the adulteration of bread, which was prevalent during this period:

"Mr. Francis Baldwin, a Baker in Sidbury, was this day convicted before the Right Worshipful Mayor of this city, of mixing allum with bread made for sale, on Christmas day last, contrary to the Act of Parliament, and paid the penalty" (Berrow's *Worcester Journal*, January 3rd, 1791).

According to *The Times* (October 20th, 1800) the price of wheat in Worcester rose to the enormous price of 19s. 6d. and 21s. a bushel, or 8 guineas a quarter, "the highest price in the kingdom." In the first half of the year 1801 also, prices were higher in Worcestershire than elsewhere. In 1803 Cobbett reported "an universal complaint of the scarcity of corn" and "in Worcester the inhabitants have issued half-crown tickets."

The weights fixed for the penny (wheaten) loaf reflect the changes in the price of wheat in the early part of the nineteenth century.

Worcester Assize of Bread

Year	Weight of Penny (Wheaten) Loaf		Year	Weight of Penny (Wheaten) Loaf	
	Lowest	Highest		Lowest	Highest
1800 ...	4 15	6 10	1812 ...	3 5	4 10
'01 ...	4 13	7 12	'13 ...	4 2	6 15
'02 ...	6 13	9 14	'14 ...	5 5	7 11
'03 ...	— —	9 4	'15 ...	6 5	8 2
'04 ...	6 1	9 4	'16 ...	4 1	8 6
'05 ...	5 6	6 5	'17 ...	3 8	6 5
'06 ...	6 1	15 13	'18 ...	5 2	5 14
'07 ...	6 10	7 12	'19 ...	5 12	7 15
'08 ...	4 15	6 10	'20 ...	6 9	8 11
'09 ...	4 6	5 13	'21 (Oct.) ...	4 14	— —
'10 ...	4 1	5 2	'22 (Oct.) ...	— —	9 14
'11 ...	5 6	6 5	'23 ...	6 9	10 11

In January 1800 the County Magistrates, at Quarter Sessions, ordered that "no makers of bread for sale, shall make, or sell, any superior quality of bread at a higher price than the standard wheaten bread; and that every peck loaf should weigh 17 lb. 6 oz., and every quartern loaf 4 lb. 5 oz. 8 dr." The practice of stating weights for the 1d. and 2d. loaves was discontinued in 1829; the smallest now being the half-quartern weighing 2 lb. 2 oz. 12 dr. The Assize of Bread fell into disuse in 1848.

During 1801 constant complaints were received that the price of provisions at Worcester was higher than elsewhere; the price of the quartern loaf was fixed by the Mayor of Worcester at 1s. 7d., the price in London on the same day being 1s. 4½d. The high prices at Worcester market during the same year caused a riot amongst the women—1s. 8d. being asked for a pound of butter,

2s. a peck for potatoes, and 9d. a pound for meat. "The mob of women prevented the Birmingham 'badgers' from carrying off their purchases; and then assembling before a baker's shop in Broad Street, compelled his wife to throw out all the bread she had in the house."

W. Pitt (*Agriculture in the County of Worcester*, 1810) gives the following prices at Worcester, September 28th, 1805:

Beef and Mutton	...	...	...	6d. to 6½d. per lb.
Lamb, Veal and Pork	...	...	...	6½d. to 7d. do.
Butter	...	...	...	1s. to 1s. 2d. do.
Cheese	...	...	...	7d to 8d. do.

At the Worcester Fair, January 20th, 1862, beef made 6d. to 6½d. per lb. and mutton 7d. to 8d. per lb.

The data we have given are decidedly scanty, and it is to be regretted that a more continuous record could not be given; nevertheless, if we have added anything—however small—to the already existing knowledge of the development of prices, some purpose will have been served.

In addition to the references mentioned in the text, information has been extracted from the following:

*Notes and Queries concerning Evesham and the Four Shires*, 1911.

*Worcestershire in the Nineteenth Century*. T. C. Turberville, 1852.

*History of Worcestershire*. J. W. Willis Bund and William Page.

*A History of Worcestershire Agriculture and Rural Evolution*. R. C. Gaut, 1939.

*The Weekly Worcester Journal* (later *Berrow's Worcester Journal*).

To the Editor of the latter I am very grateful, for his kindness alone made this article possible.

## THE UNITED NATIONS CONFERENCE ON FOOD AND AGRICULTURE

By R. J. THOMPSON, C.B.

THIS Conference \* of representatives of some 44 countries defined its objective as "freedom from want of food suitable and adequate for the health and strength of all peoples." Under-nutrition and malnutrition exist in varying degrees in all parts of the world, in many of the most densely populated areas they are chronic and wide-spread. These conditions which are traceable to historic, national and economic causes are not lightly to be overcome, but the key-note of the Conference was a call to all Governments to secure more and better food for their people.

In pursuance of this lofty aim it laid down the ground plan as it were of a policy to be pursued both nationally and internationally for raising the levels of nutrition, for the progressive expansion of production of food and other agricultural products and their fuller distribution throughout the world. There can be no question that the Conference has performed a valuable service in bringing together ideas and suggestions on these problems and in pressing on present and future Governments the obligation of investigating their possibilities. The discussions in the Sectional Reports are especially worthy of study. At the same time, it is well to bear in mind that the recommendations place on Governments the burden of discovering ways and means whereby the ideal may be translated into the practicable; they include numerous questions of profound complexity in regard to which no agreed solution has so far been discovered, and they demand national and international action on a scale far exceeding any hitherto undertaken.

The scope of the Conference covered three main lines of thought: national diets and nutrition questions, a short-term and a long-term policy of production, and the formation of an interim and ultimately a permanent organization to assist in carrying into effect the views of the Conference.

The latter is perhaps the most immediately practical of its recommendations and one which it may reasonably be hoped will be carried into effect. It is proposed that the Government of the United States should take preliminary action to establish at once an Interim Commission to consider a specific plan for an organization in the field of food and agriculture, which would act as a centre of information and advice and, among other things, maintain a service of international statistics. What seems to be contemplated is a body analogous to the International Labour Office to act as a central clearing-house in regard to scientific, technical, social and economic knowledge, and particularly perhaps to exercise a paternal influence on Governments in guiding and instructing them along the lines of progressive development suggested by the Conference itself. Its functions and duties are, however, to be more precisely defined by the Interim Commission.

\* Final Act of the United Nations Conference on Food and Agriculture, Hot Springs, Virginia, U.S.A., 18th May-3rd June, 1943. Stationery Office, Cmd. 6451. Price 9d. Section Reports, Cmd. 6461. Price 6d.

The countries represented included the U.S., the British Commonwealth, Russia, China, and the Governments directly associated with them, as well as most of the South American and West Indian countries (not including Argentina), Mexico, Egypt, Ethiopia, Iraq, Iran, Liberia, Luxembourg and Yugoslavia.

The Conference was especially emphatic on the subject of nutrition, and one of its leading recommendations was that Governments should immediately undertake the task of increasing the food resources and improving the diets of their people and should declare their intention of so doing. There are 13 recommendations on these subjects, many of them of a most comprehensive character, covering the diets of vulnerable groups, malnutrition, deficiency diseases, dietary standards and so on.

Various suggestions are made in regard to production in the short-term period after or preceding the termination of the war, the general view being that supplies of essential foods and of fertilizers and machinery will all be inadequate to meet basic requirements for several years after the termination of hostilities; those countries that can do so should, therefore, maintain or increase their production to assist in meeting abnormal demands. There are 9 somewhat indefinite recommendations here, including co-ordinated action between Governments in regard to production and distribution, the prevention of speculative and violent fluctuations in prices, and "the post-war readjustment of agriculture to achieve a progressive and balanced expansion of production and consumption throughout the world." Governments are invited "to take, individually and in concert, whether by conference or otherwise, all necessary measures, both domestic and international, to secure the achievement of these objectives." Rather a tall order, one would suppose.

As a long-term production policy, it is suggested that every country should aim at a secure, adequate and suitable supply of food, an object which, it is stated, can only be achieved as part of a world-wide policy of industrial and agricultural expansion. There are some 30 most widespread and all-embracing recommendations in regard to farming systems, agricultural credit, co-operative movements, land tenure, education and research, soil erosion, development and settlement of land, emigration, marketing, etc. Many of them are along lines which have been adopted in one country or another in connection with schemes for the promotion of agriculture.

Of a more theoretical character are statements dealing with national and international measures for wider food distribution, international security, and "the achievement of an economy of abundance." The observations on the latter subject are perhaps not unnaturally extraordinarily comprehensive. Governments are recommended to promote "the uninterrupted development and most advantageous use of agricultural and other material resources for the establishment of an equitable balance between agriculture and industry in the interest of all," to maintain an equilibrium in balances of payments, to achieve the orderly management of currencies, to reduce barriers of every kind to international trade, and to eliminate all forms of discriminatory restrictions thereon.

It was no doubt the policy of the Conference to side-track prospective difficulties and to be content with a declaration of the objects in view, but it is questionable if these objects are assisted by ignoring the fact that the methods which can wisely be adopted in regard to a proportion of the matters dealt with are either entirely uncertain or are the subject of strongly held differences of opinion. The influence which Governments can exercise on their nationals, particularly in regard to traditional farming practice and trade custom, seems exaggerated, and overlooks the probability of disagreement when these subjects are discussed in legislatures. The suggestions relating to the practical aspects of agriculture and distribution have been accepted in many countries as desirable,

but have nevertheless frequently proved difficult to bring into operation. The financial aspects of the problems, moreover, are minimized, if not ignored, to an extent disproportionate to the importance they are likely to assume in any attempt to give effect to these recommendations.

The obstacles to be met with in bringing into practical operation proposals of a far-reaching character even where there is a considerable measure of unanimity is well exemplified in the results of another international meeting held in 1942 on the subject of wheat.\* The object of this meeting, which was composed of representatives of the chief wheat-exporting countries and the United Kingdom, was to consider the problem raised by the existence of phenomenal surplus wheat stocks and to devise means for dealing with them in an orderly manner. A solution, it was stated, must be regarded as an essential part of any programme of world economic reconstruction. Its magnitude may be judged from the fact that it is estimated by the Food Research Institute of Stanford University, California, that the wheat carry-over of the chief exporting countries in 1942 amounted collectively to 1340 million bushels, as compared with 511 million bushels in 1939. These surplus stocks are described as "truly colossal," and are more than double the total exports of all countries in 1938-39; it is expected, moreover, that the figure will be further increased in 1943.

The deliberations of this meeting were embodied in a memorandum of Agreement and in a Draft Convention, which is put forward for further consideration at a Wheat Conference to be called by the U.S.A. "as soon as it deems the time propitious," but which was nevertheless so far definite that the five countries agreed that in certain circumstances it should be brought into effect as between themselves.

Some general principles are set out comparable to those of the other conference. For example, the contracting Governments agreed that an essential element of a solution of the problem is that consumers should have the opportunity and means of increasing their purchases of wheat from areas which are equipped to produce it economically. They agreed that such opportunity and means depend not only on the lowering of barriers to the importation of wheat but also on making available to wheat-importing countries increased outlets for the exportation of goods which they in turn are equipped to produce economically. It was felt, however, that these and other allied questions transcended the scope of a wheat agreement, and the delegates set themselves to devise such measures as could be applied in the near future. Briefly, these involve nothing less than the control of production, stocks, exports and prices, and are of a very detailed character; Governments are required to adopt suitable measures to ensure that the production of wheat does not exceed domestic requirements plus export quotas and stocks; minimum and maximum stocks to be held by exporting countries are prescribed, as well as methods of regulating exports by imposing agreed quotas in relation to stocks and output, the idea being to prevent shortages or gluts likely to lead to excessively high or low prices. Maximum and minimum basic prices are moreover to be fixed annually by a Wheat Council, the only guide to this thorny subject being that the prices fixed shall return reasonably remunerative prices to producers in exporting countries, be fair to consumers in importing countries, and shall be in reasonable relation to the prices of other

\* Exchanges of Notes between the Governments of Argentina, Australia, Canada, the U.K. and the U.S.A., following discussions at Washington, April-June, 1942. Stationery Office, Cmd. 6371. Price 3d.



commodities (presumably other cereals which might be used in substitution for wheat).

It will be seen from this that while the Hot Springs Conference dealing with food problems in the abstract emphasized the need for increased consumption and the general expansion of production, the Draft Wheat Convention, having to face the practical problems of an individual commodity, found itself forced to propose an extensive system of detailed control and restricted production all dependent in the last resort on the unsolved problem of prices—which must necessarily be approximately uniform, and yet are at one and the same time to be remunerative to the producer under widely differing conditions in exporting countries and fair to the consumer in the importing countries. No doubt the proposals are open to criticism at certain points, but it is important to recognize that they represent the culmination of discussions on this subject which have extended over a series of years and are the best solutions that the representatives of five leading countries were able to devise. The difficulty did not pass unnoticed at the Hot Springs Conference, which, without referring directly to the Wheat Convention, discussed the desirability of “international commodity arrangements,” including the existence of buffer stocks and the regulation of production. While giving a modified approval in principle, the main conclusion was that the subject should be studied by an international organization, so that the problem was really carried no further and remains unsolved.

The complex questions which clearly have to be faced in dealing with a world-wide commodity like wheat (and incidentally with other similar commodities) illustrate the wide divergence there may be between the enumeration of ideas which in themselves seem commendable and their application to commodities where the interests of different countries may only partially coincide.

The Wheat Convention and the accompanying documents are exhaustively analysed in an interesting review by Joseph S. Davis published in *Wheat Studies*\* issued by the Food Research Institute.

\* *Wheat Studies. New International Wheat Agreements*, Vol. XIX, No. 2, Nov. 1942. Stanford University, California.

## THE LIBRARY OF THE ROYAL STATISTICAL SOCIETY

THE Council of the Society recently re-appointed a Library Committee to consider the present position of the Library and to make recommendations for any possible improvements. It would help the Committee a great deal in their work on this subject if they could have an indication from Fellows of respects, if any, in which they have found the Library deficient.

Fellows are accordingly asked to let the Committee have any recommendations for improvement, e.g. (a) by specifying books which they think ought to be in the Library, and (b) by calling attention to any branches of statistics in which the Library needs strengthening. The Committee would also be glad of any general suggestions for improvement. Communications on the subject should be addressed to the Librarian, Royal Statistical Society, 4 Portugal Street, W.C.2.

A Suggestions Book has been placed in the custody of the Librarian, and it would be appreciated if Fellows who use the Library would note in it, from time to time, any works which they think the Society should acquire and any other suggestions relating to the Library.

Finally, the Committee ask Fellows to make a practice of sending to the Librarian reprints of any of their articles other than those printed in the Society's own publications. It is very useful to have such reprints, even if they are from periodicals which the Society possesses, because of the convenience for borrowers who wish to take them away.

*Signed*

C. OSWALD GEORGE	} <i>The</i>	
A. BRADFORD HILL		} <i>Library</i>
M. G. KENDALL		



## REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—"Student's" Collected Papers. London: Biometrika Office, 1943. 9" x 6½". xiv + 224 pp. 15s.

This issue of Student's papers under the editorship of Professor E. S. Pearson and Dr. Wishart has realized what is aptly described in their preface as "a happy project" conceived in 1938. The volume is well arranged and printed by the Cambridge University Press. The frontispiece is a pleasant portrait of an old friend, but shows him rather younger than on his occasional visits to the Society's rooms in the years before the war. A foreword by Mr. L. McMullen is an appendix which appeared (with minor modifications) in *Biometrika* in 1938. "Student" was a pioneer in the application of statistical technique to practical problems and in devising the appropriate statistical tools. Most readers will turn first to "The Probable Error of a Mean" published in *Biometrika* 35 years ago. The present-day grandiose structure of small sample theory owes its origin to this path-breaking paper. In this as in other papers a very modest use of algebra is mated with careful experimental work and deep insight into the essentials of theory.

The younger statisticians of to-day, overawed by texts bristling with existence theorems proved for Borel measurable sets, may take comfort in the thought that Gosset's "t" test was founded on an inspired guess for the form of the distribution of variance.

"Student's" contributions to statistics, in spite of a unity of purpose, ranged over a wide field from spurious correlation to Spearman's correlation coefficient. Always kindly and unassuming, he was capable of a generous rage, an instance of which is shown in his criticism of the Lancashire Milk Experiment. This was a nutritional experiment on a very large scale. For four months 5,000 school children received three-quarters of a pint of raw milk a day, 5,000 children the same quantity of pasteurized milk and 10,000 other children were selected as controls. The experiment, in Gosset's view, was inconclusive in determining whether pasteurized milk was superior in nutritional value to raw milk.

This was due to failure to preserve the random selection of controls as originally planned. "In any particular school where there was any group to which these methods (*i.e.*, of random selection) had given an undue proportion of well-fed or ill-nourished children, others were substituted to obtain a more level selection." The teachers were kind-hearted, and tended to select ill-nourished as feeders and well-nourished as controls. "Student" thought that among 20,000 children some 200-300 pairs of twins would be available of which some 50 pairs would be identical—of the same sex and half the remainder non-identical of the same sex. The 50 pairs of identicals would give more reliable results than the 20,000 dealt with in the experiment, and great expense would be saved. It may be wondered, however, whether Student's suggestion would have proved free from snags. Mothers can be as kind-hearted as teachers, and if one of a pair of identical twins seemed to his mother to be putting on weight

because of his school milk, could she be trusted not to try to make it up to the other twin by extra helpings of tasty dishes?

This is a book that all who knew "Student" will wish to have. It would make a charming prize to be awarded, if such things are done nowadays, at the end of the first year of a course in statistics.

L. I.

2.—*Mathematical Statistics*. By S. S. Wilks. Princeton, N.J.: Princeton University Press, 1943. (London: Sir Humphrey Milford.)  $10\frac{1}{2}'' \times 8\frac{1}{2}''$ . xi + 284 pp. 25s.

In 1937 the author, by the publication of his course of lectures at Princeton University on the mathematical theory of statistical inference, was perhaps the first to produce an authoritative work on this subject. This new lithoprinted publication, which contains nearly three times as many pages as its predecessor, is similarly based on a lecture course. The author, by suggesting in the preface that "the present notes" are still to be "revised and issued in permanent form," and by noting further that some omissions are dictated by the particular needs of his students, rather tends to disarm possible criticism on subject-matter and layout. However, from the title the general reader might be entitled to expect a comprehensive treatment. It is for him that this review has been written.

In the introductory chapters I and II on probability and distribution functions, the author's earlier emphasis on the von Mises approach has changed in favour of the more orthodox model, in which the probability concept, with its own axiomatic rules, has been abstracted from empirical sequences of trial results. The reader must be prepared to grapple by himself with the finer points of the abstracting process, for such ideas as stochastic convergence and the law of large numbers, which determine the logical relevance of the theory, are not very satisfactorily discussed.

A more serious criticism which soon forces its attention on the reader is the complete absence of tables of distributions and other ancillaries of the practical statistician. It may be argued that the book is not intended as a practical manual, and that such are better obtained elsewhere; nevertheless, an interesting chapter on combinatorial statistical theory, with some useful recent results in the theory of runs, is incomplete when the reader has to go back to some of the original papers for assistance in the numerical use of these results. Incidentally, the place of this chapter in the book is a mystery, for combinatorial theory is in principle one of the most primitive parts of statistical theory, yet here it is as Chapter X, well after the general theory of estimation (Chapter VI) and tests of statistical hypotheses (Chapter VII).

The subjects of the chapters still to be mentioned are III, Special distributions. IV, Sampling theory. V, Sampling from a normal population. VIII, Normal regression theory. IX, Analysis of variance. XI, Multivariate statistical analysis. It will be seen that the last four of these form a natural group, and it is odd that they are separated by chapters with no logical connection with them. The introduction of multiple correlation and the multivariate normal distribution in Chapters II and III seems very premature, and might well have been left until a thorough study of elementary distributions had been made.

Among the omissions referred to in the preface are seminvariants and characteristic functions. The use of moment-generating functions in place of the latter is taken a very long way, but is a retrograde step from the author's earlier publication. Their use in the book is moreover so systematic that the student is in danger of forgetting that direct methods may prove more illuminating. In the derivation of second-order moment distributions from univariate and bivariate normal systems (Chapter V), the brief reference in *Statistical Inference* to geometrical methods has disappeared entirely. In the multivariate case (Chapter XI) there are tardy and still only occasional references to geometrical ideas; thus it is not pointed out, in connection with Hotelling's

generalized Student test, that the sampling orientation of a single vector in  $n$ -dimensional sample space to the "plane" of  $k$  vectors is determined if *either* the variation of the single vector *or* of the "plane" has "spherical" symmetry in the complete space. This duality links multiple normal regression with Hotelling's problem, or equivalently with discriminant functions (which the author does not mention).

The rest of this last chapter on multivariate analysis is valuable in its presentation of comparatively recent results in canonical variate theory, but it is feared that many readers will find the abstract discussion, without appeal to examples, too rarefied an atmosphere for long sojourn. In this respect the book as a whole shows considerable unevenness. There is a comparatively utilitarian section on sampling inspection problems in the chapter on combinatorial theory. The analysis of variance chapter inevitably suffers from the absence of numerical examples; the algebraic detail does not emphasize strongly enough the arithmetical virtues of the technique.

Turning to the two general chapters on statistical inference, the reviewer found himself comparing them unfavourably with the earlier publication. The present chapter on statistical hypotheses is very sketchy; it omits, for example, any discussion on the relationship of sufficient statistics with most powerful tests. The preceding chapter begins with "interval estimation" and only later proceeds to "point estimation." The latter came first historically, and is still the more relevant problem in many fields, so that this inversion hardly seems justified. The limiting properties of the maximum likelihood estimate are discussed (assuming unnecessarily, however, the existence of the third derivative); the property that this estimate has smaller variance than other estimates with asymptotic normal distributions is stated, but not proved. No mention is made of the relation of the maximum likelihood statistic to the unbiased statistic with minimum variance of Aitken and Silverstone.

This book will be useful to the professional mathematical statistician; also to mathematically-minded students provided that they are not solely reliant on it; it is not recommended to the amateur, nor to the student who is more interested in method than in theory.

M. S. B.

3.—*The American-Born in Canada. A Statistical Interpretation.* By R. H. Coats and M. C. Maclean. Toronto: The Ryerson Press, 1943. (London: H. Milford.)  $9\frac{1}{2}'' \times 6\frac{3}{4}''$ . viii + [1] + 176 pp.

First, let me say that this publication is a fitting memento to the late Mr. Maclean, who contributed so much to its birth: a study of the monograph, in view of the statements of Dr. Coats, makes it clear that the statistical world has suffered a severe loss by the death of this member of the Dominion Bureau of Statistics, Canada.

Secondly, it may be pointed out that this work offers weighty support to the conclusions of the Council of the Royal Statistical Society, set out in the Memorandum on Official Statistics, by demonstrating what results can emerge from a centralized system of governmental statistics operated by statisticians of a sufficient calibre and standing.

To me, and, I suspect, to many others, the conception of the United States of America as a *source* of migration is a novel one. I must confess that, without having given special thought to the subject, I have always looked upon the United States as a reservoir into which pour migrants from the other, less-favoured nations, and from which emerge, at intervals, a small percentage of temporary visitors to the outer world: war correspondents, tourists, students, commercial travellers and business or industrial representatives. That this magnet should, in any substantial manner, lose its power and provide settlers in other countries, is to me an entirely new concept; this book makes it necessary to discard immediately the picture of a unilateral movement to the States.

The volume is extraordinarily well produced, the text and tables clear and succinct, while the technique employed is almost beyond criticism. The only

defect that occurs to me is that the graphical forms are not more numerous, but I feel that most readers will discount this as being a desire for gold-coated lilies.

To obtain the full benefit from this publication, the reader should study it in conjunction with two other works: Hansen's *The Mingling of the Canadian and American Peoples*, and Truesdell's *The Canadian-Born in the United States*. If it had done no more, this current treatise would have deserved appreciation for bringing into the foreground these two monographs: of course, it does much more. Hansen's work—which I had not previously read—gives a suggestive description of the interrelation existing between these two nations from the historical viewpoint; Truesdell tackles the problem from the converse angle to the present authors. The three works together complete a trinity of first-class importance within the selected field, a field which deserves greater recognition.

From the mass of impersonal data collected in the Census Office of Canada have emanated conclusions as to the extent and nature of this particular movement of people. Laws are formulated as a result of viewing this material over a period sufficiently long to permit it to acquire a full meaning and significance. The extent to which the generalizations drawn from the data are presented in absolute terms of mathematics makes them all the more interesting and unassailable. It is a pity that the layman, however interested he may be in the result, will not be able to share in the statistician's appreciation of the manner in which the authors have succeeded in their most difficult and arduous task, a task beset by problems of a peculiarly elusive nature, all of which have been met in a most craftsman-like manner. I hope sincerely that the conclusions at least, which are so clearly and simply stated, will become part of the intellectual background of the non-statistical student of history and of current affairs.

I think that it would be an impertinence to choose any section for particular consideration, although I was personally most interested in the part dealing with the occupational distribution of American-born, as this volume is essentially one that must be studied as a whole. I feel that I have fulfilled my duty in recommending that this work be read and studied by as wide a body of students as possible.

F. E. R.

4.—*The Theory of Prices. A Re-Examination of the Central Problems of Monetary Theory.* Volume II. By Arthur W. Marget, Ph.D. New York: Prentice Hall, Inc., 1942. 91" × 6". xxv + 802 pp. \$6.

In the introduction to his *General Theory*, Lord Keynes said, "Those who are strongly wedded to what I shall call 'the classical theory' will fluctuate, I expect, between a belief that I am quite wrong and that I am saying nothing new." Professor Marget never fluctuates at any stage in his book. He not only firmly believes that the thesis underlying the *General Theory* is entirely wrong, but also that a good deal of what Lord Keynes says is not new.

In Volume I of this work (reviewed in Part I of the 1940 series of the *Journal*) the author used what he regarded as the shortcomings of Keynes' *Treatise* as the peg on which to hang his exposition of the current state of the theory of prices. Volume II is concerned primarily with the *General Theory* and with what professor Marget calls the Keynesian controversy, "one of the greatest, if not the greatest, internecine controversies that have ever split the ranks of economic theorists." The whole of the *General Theory* is not dealt with in this book—it is chapter 21, "The Theory of Prices," which is primarily the object of the author's strictures. For the whole of Professor Marget's criticism of Lord Keynes' analysis of the forces which determine the level of employment and prices we shall have to await three more volumes, *Money and Production*, *Money and Interest* and the *Generation and Utilization of Money Income*.

In the first three chapters the author presents a detailed refutation of Lord Keynes' claim that classical theory overlooked the importance of finding a satisfactory synthesis of the general theory of value and the theory of money

and prices. He has no difficulty in showing that leading exponents of each school of economic thought, from Aristotle and the Schoolmen up to the present-day writers, have devoted considerable attention—with varying degrees of success—to this very problem. Moreover, it is a striking fact that outstanding economists, such as Wicksell, Fisher, Schumpeter and Hawtrey, each of whom has contributed substantially to received doctrine on the theory of prices, have protested against the application of the categories of the general theory of value to the problem of the value of money.

The remainder of the book is devoted to Lord Keynes' more specific claim that "our former notions of the elasticities of supply and demand" are abandoned by classical theory when it passes from the theory of value to the theory of money, and that instead we are confronted with such concepts as the quantity of money, the velocity of circulation and the volume of transactions. In dealing with this claim, Professor Marget constructs his own apparatus to account for the determination of realized money prices—an apparatus in which he seeks to embody the best of what is offered both by the general theory of value and by the theory of money and prices.

The author's apparatus may be described very simply. His objective is to analyse all the forces which determine *realized* money prices. He emphasizes the importance of discovering not only why the absolute scale of prices is what it is, but also why the structure of prices is what it is. That is to say, we have to account not only for the behaviour of the general price level, but also for the behaviour of relative prices in periods of rising, falling or stable prices. It is to the problem of the structure of money prices that concepts developed within the general theory of value, such as Marshall's elasticity of demand make their greatest contribution. Indeed, without the use of these concepts, no complete explanation of the behaviour of relative prices is possible. On the other hand, the general theory of value cannot explain the general level of prices. For this we must turn to the theory of money.

Professor Marget produces the strongly argued case which he developed in Volume I for the full use of "quantity equations" of the form  $MV = PT$  in accounting for movements in the general level of prices. In the author's analysis, the quantity equations (which must be distinguished clearly from the quantity theory) have two rôles to play in the theory of prices. First of all they provide convenient chapter headings for a detailed analysis of the forces which determine the general level of prices. Second, they can assist in the explanation of the movement of relative prices by providing the model for the development of partial equations designed to deal with particular problems, such as the relation between the volume of bank money and the level of security prices. In other words, stream equations of the Fisher type can be transformed into the instruments of analysis of both the macro-economic and micro-economic types. Further advantages of the use of quantity equations lie in the fact that in presenting the process through time of the impact of a stream of purchasing power against a stream of objects to be purchased, they make it possible to separate changes in prices from changes in the quantity of goods sold at those prices. Furthermore, they offer the possibility of verification, since it is possible to find statistics to show how each variable included in the equations has varied in any given period.

Professor Marget's conclusion is that the theory of prices as presented in the *General Theory*, far from having introduced "an unprecedented rate of obsolescence" in economic and monetary theory, must be regarded as retrograde. Not only has it failed to provide a satisfactory synthesis between the general theory of value and the theory of money and prices or to make use of certain concepts fundamental to this synthesis, but the development of new concepts, such as the aggregate supply function, the elasticity of effective demand and the application to money of the elasticity of substitution and the elasticity of supply have left theory in a more confused and backward state than previously.

This is a grave claim and one which most students of recent monetary

theory will be reluctant to accept. Professor Marget does not dispute the obvious fact that the value of any economic theory lies within its ability or failure to provide a satisfactory explanation of the behaviour of the economic system as we see it. Whether or not Lord Keynes has misrepresented the substance of the classical theory of prices, whether or not certain of the concepts developed may be unsatisfactory from the standpoint of a fresh direction and impetus to current thought, it is an undeniable fact that the *General Theory* has given a more adequate and acceptable general explanation of the broad tendencies of the behaviour of the economic system of the United Kingdom and the United States in the inter-war period than any other theory.

Let us consider one aspect of Lord Keynes' theory of prices against which Professor Marget has directed special criticism. Lord Keynes argued that in certain circumstances the level of prices could be regarded as determined by the cost of the wage unit—an argument which is designated by Professor Marget as "the crudest version of the labour theory of value." Now, it must be clear to any student of the past fifteen years that wages have come to play an increasingly important rôle in the determination of the level of prices generally, and have indeed come to play the part which Karl Marx thought they ought to play. The reasons for this are not far to seek. The social conscience no longer tolerates the position in which labour is the "ballast" of the economic system. Organized labour has become increasingly aware of the economic facts, with the result, *inter alia*, that the time lag in the movement of the cost-of-living bonuses after prices has been shortened; national price-fixing bodies have tended to regard wage increases as the only valid reason for increasing prices; the non-labour costs of production have frequently been subject to special taxation and other restrictions. These tendencies have naturally become more marked in war-time (vide the relation between farm prices and farm wages in the U.K.). It is thus difficult to see how the author's attack upon Lord Keynes' proposition can be sustained by fact.

The above criticism of the bias underlying this book need not detract from the solid virtues of the author's exposition. Nothing but praise can be accorded his insistence that a proper theory of prices must embrace the best concepts developed both within the general theory of value and the theory of money. There has been a regrettable tendency in recent years for economists to claim for their own theories, not only that they explain uniquely the whole economic process, but that they render out of date all preceding theory on the subject. For example, undoubted harm has been done by the extravagant claims made on behalf of the *General Theory* by some of Lord Keynes' less restrained disciples. Professor Marget, on the contrary, argues with great force that many concepts which have been regarded as mutually exclusive are, in fact, supplementary. Before we abandon any concept which has been of value in the past, we should therefore consider carefully whether it may not still have a rôle, albeit less important, to play in the new theory.

On the other hand, Professor Marget does not seem to have emphasized adequately the relation between economic concepts and the economic facts of the period during which they were developed. With changing economic circumstances, the relative importance of concepts inevitably must also change. The labour theory of value again produces a useful example. Before the emergence of large-scale capitalistic production, wages were undoubtedly the primary factor which determined the long-term scale of prices generally. The importance of wages in the total cost of output subsequently tended to shrink substantially. However, the cycle is now complete and in an age in which the marginal efficiency of capital could, in Lord Keynes' words, be reduced to zero in a relatively short period, wages have come again to play the leading rôle in the determination of prices.

One last point. If his books are to receive the wide attention which they deserve, the author must change their format. It is extremely difficult to read this book, mainly because there is virtually no page which does not carry at least one footnote, and many pages consist of nothing but footnotes. J. E. W.



5.—*Standards of Local Expenditure*. By Professor J. R. Hicks and Mrs. U. K. Hicks. National Institute of Economic and Social Research, Occasional Papers No. III; Cambridge University Press, 1943. 4s. 6d.

In this instructive and stimulating piece of research Professor and Mrs. Hicks set out to answer two important questions:

(1) What are the reasons for such wide disparities in the rate poundages of different towns?

(2) Why have the measures taken since 1928 for the relief of rates been so utterly unsuccessful in reducing the burden on other than industrial property?

In point of fact the inequalities in rates are even greater than appears on the surface, for it is stated in the admirable introduction that the authors have been conducting a parallel investigation into the variations in valuations for rating, and that this has shown that low valuations usually accompany low poundages, and high valuations high poundages.

As a result of their detailed and careful analysis, the authors are able to supply definite answers to these two questions. Firstly, the main reason for disparities in rates is disparities in wealth. Towns at the same level of wealth vary, of course, to a certain extent, in their propensity to spend, but, generally speaking, this is of less importance than differences due to differences in wealth. Secondly, there have been four ways in which the increase in local expenditure since 1928 has led to renewed pressure on the rates.

(i) Education grants have failed to keep step with the growth of total expenditure on education.

(ii) The change from a specific percentage grant to a block grant system left the local authorities to bear almost the whole of the increased cost of certain rapidly expanding health services, namely, Maternity and Child Welfare and Tuberculosis Services.

(iii) In some cases there has been very great pressure upon the rates from hospital expansion which may have been stimulated by inequalities produced by the abolition of the Boards of Guardians. It seems possible also that further anomalies in hospital expenditure are to be explained by the presence or absence of adequate facilities from voluntary hospitals.

(iv) The transference of the able-bodied unemployed failed to diminish the cost of public assistance to the local authorities, because of the revolution in standards of assistance due to the influence of the Unemployment Assistance Board in showing up local shortcomings.

A word here on the method adopted by Professor and Mrs. Hicks to analyse expenditure into its various categories is of interest. Clearly some method of grouping the local authorities was essential if the broad facts of the situation were to be readily appreciated, but equally clearly care had to be taken in choosing the groups to avoid the loss of valuable and relevant information. What was done was firstly to arrange the eighty-three county boroughs in order of yield per head of a penny rate. This list facilitates classification of the county boroughs as wealthy, moderately wealthy, or poor. Now, going down the list and taking account of geographical (in rather a wide sense) considerations the outline of a satisfactory grouping is immediately apparent. At the head of the list are the seaside resorts (Eastbourne, Bournemouth, Blackpool, etc.) and this is clearly a convenient first group. Then come the cathedral towns (Bath, Canterbury, Exeter, etc.), which is a second. At the lower end of the scale are the poor local authorities; some of them spending rather more (the "Poor Spenders," such as Barnsley, Oldham, South Shields, Wigan, etc.) than others (the "Poor Stinters"—for example, Dudley, Smethwick, Tynemouth, etc.). Finally, in the middle of the scale the moderately wealthy towns can be divided into two groups: the "Big Spenders" (Bradford, Liverpool, Manchester, etc.) and the "Middling Stinters" (Barrow, Bury, Darlington, etc.). This is

the broad outline of the method of grouping adopted, and it will be readily understood that great care has been taken by the authors in drawing it up. Likewise in the analysis of expenditure much trouble has been taken to ensure that the data presented shall not be misleading.

Having come to their conclusions on the facts of the problem, Professor and Mrs. Hicks have some pertinent comments to make on the policy it is desirable to adopt in face of the results of their enquiry. Their solution would be to remove the whole of domiciliary relief from local control and local financing and, with this special problem out of the way, revise the block grant formula so that it could become a really effective equalizer—that is, the block grant could be made mainly dependent on the wealth or poverty of an area. In this way not only should we obtain a local government which was financially more equitable, but also, by removing the rather sordid function of public assistance from the local orbit, the centre of gravity of local government would be shifted to those functions (such as “education” or what Professor and Mrs. Hicks term “civic amenities”) in which local enthusiasm and devotion could be more easily aroused. Thus local government should also become a more effective organ of democracy.

This study was already completed at the time the Beveridge Report was issued, but the conclusions reached were very much in harmony with Sir William Beveridge's proposals. Despite this, however, the authors felt that there were certain dangers in the Beveridge plan which ought to be indicated, and so they made no change in the body of the book, but added an epilogue on the Beveridge proposals. This points out that the estimated additional cost to the National Exchequer of the Beveridge scheme may be something more like £105m. rather than the £86m. quoted in the report, unless some alteration is made in the financial relations between the central government and the local authorities. This is because the cost of local public assistance is included in the cost of existing services as a local charge, but in the estimated cost of the proposed services the charge has become one falling ultimately on the central government. It seems clear that the Chancellor of the Exchequer of the time will insist on extracting this extra £20m. from the local authorities, and here lies the danger that an undue proportion of the cost might still be laid upon the poor authorities. Then, again, there is a possibility of a disproportionate burden being laid on the poorer authorities in the development of hospital and rehabilitation services. For one fact brought to light in these researches is the amazing disparities in expenditure on institutional relief (including general hospitals)—anomalies which are very difficult to explain. For example, Brighton spends more than 19s. per head, yet Blackpool, Bournemouth, and Southport each spend less than 7s. per head. The high rates of Salford and possibly of West Ham appear to be largely due to their abnormal hospital expenditure. Thus, if anything like a proportional development of hospital services were to take place, there would be a danger of a disproportionate burden being placed on some of the poorer authorities.

K. S. L.

6.—*Modern Commercial Policy*. By R. D. Tiwari. Bombay: New Book Company, 1942. 8½" x 5½". xviii + 473 + x pp.

The author attempts to demonstrate that the present conflict is largely, if not entirely, attributable to the economic policies, fundamentally fallacious, exercised by the leading industrial powers since the first world war: the reader must judge for himself whether the hypothesis is proved. Professor Tiwari has taken great pains to analyse in great detail the various methods employed by the nations, particularly Great Britain, India and the United States, to implement their desire to strengthen their hold upon the world markets. He endeavours to show that this economic activity, amounting in many cases to an unconscionable greed, has involved the employment of methods inimical to world prosperity and peace. He submits that the catastrophic era of to-day is a direct and potent reason why these methods should be re-examined and redrafted in order that the experiments in post-war reconstruction shall

not lead to further causes of international strife. I do not think that there can be any dispute as to the wisdom of subjecting these devices to a most searching examination, if the mistakes of the past are to be avoided and the fullest utilization of the resources of the world, for the benefit of the people of the world, is to be made.

The analysis centres on such systems as quotas, exchange controls, clearing agreements, import monopolies and milling regulations. Prof. Tiwari's thesis suggests—in general terms—that these are not inherently bad, but that the manner in which they have been used has proved disastrous. By an uneconomic employment, these systems have, in his opinion, restricted the natural flow of international trade, and thereby have adversely affected the lives of the inhabitants of most countries of the world. In addition, the technique used has given rise to strained relations between countries, economic and political instability, suspicion and misunderstanding; these in their turn have encouraged further restrictions. So the wheel turns.

The study begins with a concise and informative history of the evolution of the commercial policy of Great Britain (from 1651), of France (from 1789), of Germany (from 1800), and of the United States (from 1782). On the basis of this it is concluded that protective tariffs have played an important part in stimulating the growth of modern industry and commerce; that a moderate policy of protection, dictated by reasonable national economic requirements, helps to secure the best use of national resources and, therefore, to maximize the national dividend; that such a policy should be directed by an expert, independent board whose aim should be to eliminate wasteful tendencies, and that sudden changes and reversals of policy are dangerous and should be avoided. (The *italics* are mine); they are, surely, the "niggers in the wood-pile."

Next, the changes occasioned by the last war are reviewed, and their effects weighed. The Treaty of Versailles is, as might be expected, placed in the dock and condemned, in no uncertain terms, for the evils it introduced. To this source the author attributes the instability of the post-1918 period and the depression which ensued: these conditions, in their turn, gave rise to the policies to the criticism of which the author devotes the main part of his book.

In an endeavour to demonstrate that the methods themselves are not inherently unsound, the fault lying in their application, Prof. Tiwari makes a thorough examination of the commercial treaties and tariff bargaining methods which came into being in this period. In his opinion, their use, based upon the exercise of goodwill and understanding, would largely have avoided the evils that arose. Quotas are accepted by the author as having a temporary value if well considered, but it would be desirable to eliminate them eventually. Exchange control of a moderate kind is accepted, even after currency stabilization is attained, as being desirable, in that it would prevent a sudden "flight of capital," but the rationing type of control is to be relaxed and gradually abandoned. Clearing agreements are to be retained but modified with a view to making exchange and market rates coincide; currencies, in the author's view should be stabilized to remove the disparities between internal and world price levels. Similarly the "most-favoured-nation clause" is dealt with, a plea being made for a liberal interpretation of its application.

Lastly, the Trade Agreements Programme of the United States, the Ottawa Trade Agreements, British Commercial Treaties and Indian Commercial Policy are considered with uniform thoroughness and relevant proposals for the future made.

This thesis contains much controversial matter and tends on occasions to approach the region of propaganda. In short, the publication will probably be valued more as an encyclopædia of international commercial policy than for its specific conclusions. Maybe entirely new methods would prove more beneficial than the continuance of existing systems whose success depends so largely upon a spirit of co-operation and goodwill.

F. E. R.

7.—*Accounts Receivable Financing*. By Raymond J. Saulnier and Neil H. Jacoby. New York: National Bureau of Economic Research. 1943. 9 $\frac{1}{4}$ " x 6 $\frac{1}{4}$ ". xv + 155 pp. \$1.75.

This work, which forms part of the series of studies published by the N.B.E.R. under the heading of *Studies in Business Financing*, is a very able summary of a characteristic, short-term financial practice in the United States. The book deals exclusively with the financing of invoices or "Open Accounts"; loans made in respect of instalment accounts or on any other security are not discussed.

There are three types of agencies engaged in financing invoices: *factoring companies*, operating mostly in the textile industry; *commercial finance companies*, with about 70 per cent. of their business in various manufacturing lines; lastly, the *commercial banks*, whose interest in this field is of recent growth. The importance of the three agencies can be gauged from the following table:

*Estimated Volume of Sales Financed, \$ Mn.*

			1940	1941
Factoring Companies	...	...	800	1150
Commercial Finance Companies	...	...	411	536
Commercial Banks	...	...	826	952
TOTAL: Million \$	...	...	2037	2638

The cost to industry of this financial service seems to amount to an average effective rate of interest of about 6 per cent. per annum in the case of factoring companies; 7 to 14 per cent. for commercial finance companies, and 8 to 12 per cent. for banks. The charges vary because the services given are not uniform. The factoring companies prefer an outright purchase of the invoices and thus assume the full burden of risk. Banks and finance companies generally seek security in some form of floating assignment; this requires continuous supervision, "credit appraisal" and regular audits. These additional services are greatly appreciated by industry and the general tendency is to rely more and more on the guidance of financial institutions in matters of marketing and granting credits to customers, even in cases where financial pressure is completely absent.

The total expenses of the factoring companies represents 70 to 80 per cent. of their gross income. This figure is about 60 per cent. for commercial finance companies. Keen competition ensures that the return on capital employed in these financial institutions is not excessive. It is difficult to draw further conclusions from the analysis of expenditure given in the book, for the samples taken are far too small.

This study appears to be the first full description of a useful financial service, the origins of which can be traced back to the fourteenth century. The economist and the business man may both find the book well worth reading.

G. A. B.

## STATISTICAL NOTES

## (1) BRITISH OFFICIAL STATISTICS

THERE was very little general change in *wholesale prices* during the third quarter of 1943. According to the Board of Trade wholesale prices index-number prices of food fell about 1½ per cent.; those of industrial materials and manufactures rose about 0.6 per cent. The principal decreases in food prices were in those of English wheat and English malting barley, and of wet fish, with some seasonal fluctuations in fruit and vegetable prices. On the other hand, there was a rise in the price of sugar (cubes and granulated). As regards industrial materials, jute prices fell more or less continuously during the three months, and there were advances in the prices of crude palm oil (34 per cent.), soap (about 20 per cent.) and imported hides. The index-numbers for coal, metals and cotton remained stationary throughout the period. The rise in the general index-number as compared with September 1942 was only about 2½ per cent., and as compared with September 1941 about 5.6 per cent. Since the beginning of the war general wholesale prices have advanced 66 per cent.—food prices 75.7 per cent. and prices of industrial materials and manufactures 61.2 per cent. The group index-numbers showing the largest advances were those of cereals, 101.7 per cent., basic materials, 85.4 per cent. and food other than cereals and meat, 83.5 per cent., but the inclusion of tobacco in this group, with the much increased duties thereon, accounts for a large portion of the advance. The group showing the smallest rise in prices was that of non-ferrous metals (25.2 per cent.), but, with the exception of tin, all the metals included in this group have been controlled since nearly the beginning of the war, both as regards prices and supplies.

(Averages for the year 1930 = 100)

Date	Total food	Total not food	All Articles	Basic Materials (excluding fuel)	Intermediate Products	Manufactured Products	Building Materials
June 1943 ...	161.3	163.7	163.1	173.9	171.4	154.3	150.0
July 1943 ...	164.0	163.5	164.0	173.3	171.4	154.2	150.3
Aug. „ ...	158.2	163.9	162.2	173.1	171.8	155.0	150.4
Sept. „ ...	158.8	164.7	162.9	175.2	171.9	155.9	150.4
Sept. 1942 ...	154.1	161.1	158.9	167.3	170.7	153.2	147.3
„ 1941 ...	147.1	157.7	151.3	170.1	166.7	149.1	140.3
Aug. 1939 ...	90.4	102.2	98.1	91.6	101.0	108.7	101.1
Percentage increase in Sept. 1943 over—							
Sept. 1942 ...	3.0	2.2	2.5	4.7	0.7	1.8	2.1
„ 1941 ...	8.0	4.4	5.6	2.8	3.1	4.6	7.1
Aug. 1939 ...	75.7	61.2	66.0	85.4	65.1	43.4	44.5

The figures for certain other British index-numbers of wholesale prices and those of the United States Bureau of Labour are given below.

Date	Board of Trade (1930 = 100)	<i>Economist</i> (1927 = 100)	<i>Statist</i> (1868 = 77 100)	<i>The Times</i> (1913 = 100)	U.S. Bureau of Labour (1926 = 100) *
June 1943 ... ..	163.1	114.8	155.4	178.3	103.6
July " ... ..	164.0	114.7	156.0	177.9	102.9
Aug. " ... ..	162.2	114.3	154.4	177.1	102.8
Sept. " ... ..	162.9	114.3	154.6	177.2	102.9
Sept. 1942 ... ..	158.9	112.8	149.7	176.3	99.3
" 1941 ... ..	154.3	107.1	145.5	171.2	91.3
Aug. 1939 ... ..	98.1	70.3	90.4	114.5	74.8
Percentage increase in Sept. 1943 over—					
Sept. 1942 ..	2.5	1.3	3.3	0.5	3.6
" 1941 ...	5.6	6.7	6.3	3.5	12.7
Aug. 1939 ...	66.0	62.6	71.0	54.8	37.6

Mean of weekly prices.

Although the British general index-number of the Board of Trade shows over the whole period of four war years a considerably larger increase (66 per cent.) than is shown by the U.S. general index-number (37.6 per cent.), there is a very close correspondence in the increase shown by the British group index for "Cereals" (101.7 per cent.) and the United States index for "Farm Products" (101.2 per cent.), and the correspondence has been noticeable at several points during the period.

There were very few changes in the *retail prices* of food and other articles of domestic consumption of working-class families during the third quarter of 1943. The index-number prepared by the Ministry of Labour to show fluctuations in the cost of living of such families fell from 200 at July 1st, 1943, to 199 at October 1st. There was an increase of 1d. per lb. in the price of granulated sugar in September, and over the quarter there were changes in the prices of potatoes consequent on the introduction of the new season's crop, resulting in a considerable reduction in the prices current in September. Prices of milk also fell and rose during the period, remaining somewhat higher on the whole in most districts in Scotland. There was a continuance of the decline in the prices of clothing, due to the increase in the quantities of "utility" cloth and apparel on sale, but the decline did not amount to more than  $1\frac{1}{2}$  per cent. over the period. There was an increase of 1d. per lb. in the permitted maximum price of soap.

The following table sets out the index-numbers for the various groups of articles.

(Prices at July 1914 = 100)

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items	All Items
July 1st, 1943 ...	168	164	345-350	244	286	200
" 31st, " ...	167	164	345	244	286	199
Sept. 1st, " ...	166	164	345	244	291	198
Oct. 1st, " ...	168	164	340-345	244	291	199
Oct. 1st, 1942 ...	162	161	390	211	266	200
" 1st, 1941 ...	165	161	385-390	229	231	199
Sept. 1st, 1939 ...	138	162	205-210	180-185	180	155
Percentage increase at Oct. 1st, 1943, over Sept. 1st, 1939	22	1	65	34	63	28

The rise of 44 points in the index-number since the beginning of the war represented at October 1st, 1943, an increase of 28 per cent. Nearly 3 per cent. of this is calculated to be due to the increased taxes on tobacco, cigarettes, sugar and matches, and rather less than 1 per cent. to the incidence of the purchase tax.

*Employment* continued at a very high level throughout the three months from the middle of July 1943 to the middle of October, and there was an unsatisfied demand for labour in many industries. The number of unemployed on the registers of the employment offices of the Ministry of Labour and National Service at October 18th, 1943, was 73,936. Of these 41,388 were males over 18 and 15,874 were females over 18. The numbers are exclusive of 19,405 men classified as unsuitable for ordinary industrial employment and 569 women unsuitable for normal full-time employment. Of the 15,874 women unemployed 403 were classified as unable for good cause to transfer to another district.

The numbers recorded as unemployed at certain dates are given below.

Date	Wholly Unemployed	Temporarily Stopped	Persons normally in Casual Employment	Total	Males	Females
Dec. 14th, 1942 ...	81,943	2,023	2,858	86,824	57,053	29,771
Jan. 12th, 1943 ...	93,708	3,114	2,195	99,017	61,709	37,308
April 12th, " ...	76,769	1,312	2,010	80,091	53,838	26,253
July 19th, " ...	71,129	1,118	1,011	73,258	50,236	23,022
Oct. 18th, " ...	72,253	732	951	73,936	49,809	24,127
Oct. 12th, 1942 ...	96,017	2,196	2,867	101,080	64,872	36,208
" 13th, 1941 ...	185,850	20,452	9,897	216,199	113,071	103,125
" 14th, 1940 ...	635,431	171,082	28,338	834,851	456,590	378,261
Aug. 15th, 1939 ...	968,108	211,978	51,606	1,231,692	947,099	284,593

## (2) OTHER STATISTICS

The *Statistics of Failures* in the United Kingdom and Ireland, issued annually by Mr. Richard Seyd, show a total of 403 in the year 1943 compared with 548

in 1942 and 5,550 in 1938. Of the 403, 18 occurred in Eire (4 among retailers, 14 in the professions). The 385 in Great Britain and Northern Ireland were distributed as follows: wholesale trades 30; retail trades 220; professional, financial and private persons 135 (the corresponding figures for 1942 were 36, 363, and 149 respectively), highest number of failures in the wholesale trades was 5 (commission agents and also metal merchants, etc.). Among the retail traders, clerks and commercial travellers head the list with 25, and are followed by builders, and grocers, etc., with 18 each; plumbers and gasfitters had 14. There were 27 failures among farmers.

In the professional classes there were 17 failures among auctioneers and house agents and the same number among officers in the army and navy, active and retired; 74 failures were those of private persons.

In addition to the failures, 958 Limited Companies were wound up voluntarily on account of liabilities (857 in England, 66 in Scotland, 12 in Northern Ireland, 21 in Eire); of these, 53 were in the wholesale, etc., trades, 38 in the retail trades, and 3 among the professional classes, etc.

#### CURRENT NOTES

The type of Part IV of the Final Report on the *Census of Production 1935* has been destroyed. The Board of Trade, however, have corrected proofs covering the following trades:—

- Paper, Printing and Stationery
- Timber
- Clay and Building Materials
- Building and Contracting
- Mines and Quarries
- Public Utility Services
- Government Departments

In view of indications that there is a considerable demand for this volume at the present time, the Board of Trade are arranging with the Stationery Office for the proofs to be reproduced in sections. The first section to be reproduced is that relating to the Building and Contracting Trade, the Clay and Building Materials Trades and the Timber Trades. This section will contain roughly 200 pages about 10" x 8" and will cost 15s.

In order that the requisite number of copies can be reproduced, it is necessary to ascertain the demand. Accordingly, all those who would desire to obtain a copy, or copies, of the Building Trades section are requested to communicate as soon as possible with the Assistant Secretary, Statistics Department, Board of Trade, Romney House East, Tufton Street, S.W.1, through whom alone copies will be obtainable. They are requested at the same time to say whether they will require copies of the other sections if and when they are reproduced.

Owing to the war, Part V of the Census of Production Report will not be produced. Copies of a number of tables summarizing the results of the Census can however be obtained from the Board of Trade at the above address, price 2s. 6d. A note concerning these appeared on page 249 of Part III of the *R.S.S. Journal*, 1942.

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We are asked by the Trustees of the Beatrice Webb Memorial Fund to make known its objects. They are: ~~The~~ <sup>The</sup> advancement of education and learning with respect to the history and problems of government and social policy (including socialism, trade unionism and co-operation) in Great Britain and elsewhere

(a) by research;

(b) by lectures, scholarships and educational grants; and

(c) by such other educational means as the Trustees may from time to time approve.

The Trustees are the Rt. Hon. A. V. Alexander, Sir Walter Citrine, Mrs. Margaret Cole, Professor H. J. Laski, Dame Anne Loughlin, Mr. R. A. Palmer, Mr. John Parker, M.P., Lord Sankey, Sir Ernest Simon, Professor R. H. Tawney. The fund is to be registered as a charity, and the intention is to raise not less than £50,000, which should ensure a worthy Memorial. Cheques should be sent to the Webb Memorial Fund, 20 Grove End Gardens, London, N.W.8, and further particulars may be obtained from that address.

## OBITUARY

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## PROFESSOR JOHN HILTON

PROFESSOR JOHN HILTON, who died on August 28th, 1943, in his sixty-third year, had been a Fellow of the Society since 1920. In recent years his energies had been fully absorbed by his duties as Professor of Industrial Relations at Cambridge University, by the work involved in the preparation of his numerous broadcast talks on a wide range of topics, and by his activities as a journalist and director of an industrial advice bureau. During the period from 1920 to 1931, however, he had been one of the most active members of the Society. He served on the Council from 1925 to 1927 and from 1928 to 1931; contributed papers on (a) "Statistics of Unemployment derived from the Working of the Unemployment Insurance Acts," in 1923, (b) "Enquiry by Sample; an Experiment and its Results," in 1924, and (c) "Some Further Enquiries by Sample," in 1928; and frequently took part in the discussions at the monthly meetings.

After a varied early career as engineer, works manager, lecturer, journalist, and secretary of the Garton Foundation, he entered the Ministry of Labour in 1919 and was appointed in January, 1920, to be Director of Statistics in that Department. The extension of the unemployment insurance scheme, by the Act of 1920, to cover over 12 million workpeople provided an opportunity, which he seized with characteristic enthusiasm, to develop a series of statistics providing information as to the numbers unemployed, and their classification by sex, age-groups and industries, more comprehensive and detailed than those of any other country. He also instituted a number of special enquiries in order to obtain detailed information relating to the personal circumstances and the industrial and insurance history of small random samples of the persons registered as unemployed, from which inferences might be drawn as to the composition and characteristics of the whole body of unemployed persons. An account of the methods used in a series of these enquiries, made in the period 1923-1927, was given in two papers which he read before the Society in 1924 and 1928, referred to above. By a succession of similar enquiries subsequently undertaken by the Ministry of Labour on a sample basis, information of great value was provided with a relatively low expenditure of time and labour, and to John Hilton is due the credit for the inception of this series of investigations.

During the same period, Hilton made a substantial contribution to the international standardization of statistics relating to conditions of labour. Between 1923 and 1931 he attended a number of Conferences of official labour statisticians convened by the International Labour Office, at which a large measure of agreement was reached as to the steps to be taken in order to secure greater comparability in the statistics, compiled in the different countries, relating to employment and unemployment, wages and hours of labour, cost of living, industrial disputes, etc. He acted as chairman of the third and fourth of these Conferences, held in 1926 and 1931 respectively. He was an effective speaker and a good chairman, and no small part of the success of these Conferences was due to his efforts and personality.

In 1931 he was selected to occupy the newly-established Montague Burton Chair of Industrial Relations at Cambridge, and from that date onwards the increasing demands on his time, made by the duties of that position and by an ever-widening range of other activities, left him with few opportunities for attendance at the monthly meetings of the Society. His sudden death after a short illness, following soon after a long and arduous tour of the Forces in North Africa, brought a sense of personal loss to large numbers who knew him only through his broadcast talks. By those of his colleagues, in this Society and in official statistical circles, who knew him well enough to appreciate his kindness of heart, his never-failing tolerance and sense of humour, and the charm of his vivid personality, he will long be remembered with admiration and affection.

E. C. R.

LORD MESTON

1865-1943

To write an obituary notice of a former chief and friend of over thirty-three years' standing is at the best of times no easy matter. We, Fellows of the Society, remember with gratitude our indebtedness to our President at the time of the centenary celebrations some years ago. Sagacious in council, profound in learning, kindly in heart, this distinguished man of affairs guided our affairs at that time with a patient devotion which was a permanent wonder to those of us who realized the burden of other work which he carried with a smile.

Lord Meston was born in Aberdeen on June 12th, 1865, the son of James Meston, Registrar for the parish of Old Machar, Aberdeen. At Aberdeen Grammar School, where Lord Byron received part of his education, he was Dux and Town Council Gold Medallist. He passed from the University of Aberdeen into the Indian Civil Service in 1883, when eighteen years of age, and went to Balliol College, Oxford. After the usual probationary period, at that time two years, he was posted to the United Provinces. In 1897, after twelve years' service, he was selected by Sir Antony (afterwards Lord) Mac-Donnell for the post of Director of Land Records and Agriculture, and two years later was appointed Financial Secretary to the Government, a post which he held until 1903. It was here that his flair for finance marked him out for the financial Secretaryship of the Government of India. Early in 1905 he was deputed to South Africa to advise the Governments of Cape Colony and the Transvaal on Civil Service reform which laid the foundation of well-organized public services there. In 1907 he was appointed officiating Secretary in the Finance Department of the Government of India, where much of the best work of his life now lies buried in files and despatches. In 1908 he was confirmed; in the following year, and until 1912, when he was appointed as successor of Sir John Hewitt, Lieutenant-Governor of the United Provinces, he was the right hand of the Rt. Hon. Sir Guy Fleetwood Wilson, Finance Member of the Viceroy's Council, and the able adviser in things financial of more than one Viceroy. During his tenure of office in the United Provinces he was Chancellor of the University of Allahabad, where he delivered annual Convocation addresses which in breadth of mind and beauty of diction have still no equal. In 1917 he came into touch with the ardent reformer, Mr. Edwin Montagu, Secretary of State for India. In 1918 he resigned his appointment.

to become for only a short period Finance Member of the Viceroy's Council. Owing to his eyesight he decided in 1919 not to return to India, and he declined Mr. Montague's offer of the Permanent Under-Secretaryship of State for India at the India Office on the retirement of the late Sir Thomas Holderness. He was for his services raised to the peerage, and took the title of Lord Meston of Agra and of Dunottar, in Kincardineshire, the latter recalling incidents in which an ancestor took part in Jacobite days. His elevation was due to the part which he took in the Montagu-Chelmsford reforms, which were embodied in the Government of India Act 1919.

It was at this point that Lord Meston turned to a most successful career in the City, being ultimately Chairman of nine limited companies and director of five others. In spite of his great commitments in the City he was able to take an interest in other directions. He became, for example, president of the Liberal Party organization and chairman of the National Liberal Club. Lord Crewe rightly emphasized in *The Times* his outstanding position as a worker for Liberal principles in difficult days. In the General Election of 1923 he was, he said, "an organizer and exponent of opinion" who was invaluable and "he thus became without question head of the new Liberal Organization and most efficient chairman of the National Liberal Club." The Royal Institute of International Affairs and the Standing Commission of the League of Nations are under a debt of gratitude to him for his financial authority and for his gift for conciliation, which amounted to genius. Few in our time have contributed more to the public service in so many countries. In 1928 he was elected Chancellor of his own old University of Aberdeen, an honour which he greatly prized. He was an LL.D. of the Universities of Aberdeen and Edinburgh, an Hon. Doctor of Zürich, and an Honorary Fellow of University College, London. He was a freeman of the Cities of London, Manchester, and his native city, Aberdeen. Only one of his predecessors in the Indian Civil Service—John Lawrence—was raised to the peerage for exclusively Indian service.

The writer of this notice remembers the late Lord Stamp's view of Lord Meston. Both, of course, belonged to the same liberal school of thought and politics. Both were self-made men of the highest ability and character. Both were eminently successful in business. Lord Meston's election to the Presidency of the Society was eminently successful for the Centenary year. He had to be elected a Fellow in order to be eligible as President. He read an address on Indian Statistics in 1932 and spoke on a Presidential Address at a meeting after he ceased to be President.

Lord Meston won golden opinions from all sorts of people, from the highest to the lowest in the land. His urbanity and his character made those of us who worked under him feel that he had a special gift, like Lord Milner, of getting the best out of his fellow-workers. One can recall a very difficult case in the Finance Department of the Government of India when he completely redrafted a long despatch to the Secretary of State for India which had been put up to him. He gave the credit to his subordinates for the excellent draft which really was his own. The Finance Member minuted "This is a State-paper of the first importance which the Viceroy should see," and the Viceroy in turn minuted "This makes me ask what we shall do when Sir James Meston leaves us," or words to that effect. His beautiful handwriting is never to be forgotten. He was untiring in administration, a scholar and a man of affairs,

loyal in co-operation and devoted in friendship. The news of his death on October 7th, 1943, in a nursing home at Maidenhead, recalled the lines :

They told me, Heraclitus, they told me you were dead,  
They brought me bitter news to hear and bitter tears to shed.  
I wept as I remember'd how often you and I  
Had tired the sun with talking and sent him down the sky.  
And now that thou art lying, my dear old Carian guest,  
A handful of grey ashes, long, long ago at rest,  
Still are thy pleasant voices, thy nightingales, awake:  
For Death he taketh all away, but them he cannot take.

G. F. S.

## STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

### UNITED KINGDOM—

#### *Agenda—*

*August 1943*—The British and American Monetary Plans: *Barrett Whale*. Reconstruction in Australia: *L. F. Giblin*. Raw material controls and post-war economic policy: *G. D. N. Worswick*. Methods of Mass-observation, with particular reference to housing: *Celia Goller*.

*November 1943*—Social security planning in the United States: *E. M. Burns*. The financial system in post-war Britain. The future treatment of adult offenders: *Margery Fry*. The economic reconstruction of India: *Vera Anstey*. Post-war forest policy: *Reginald Lennard*. The demand for dwellings in Great Britain after the war. I: *M. A. Abrams*.

#### *The Banker—*

*September 1943*—Price control in the post-war transition phase.

*October 1943*—The future of Banking.

*November 1943*—A world bank: *Paul Einzig*.

*December 1943*—The composite combine: *Hermann Levy*. Insurance in 1943. The Netherlands West Indies: a financial and economic survey.

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#### *Economica—*

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*December 1943*—Full employment and security of livelihood: *R. F. Harrod*. Rubber production costs during the great depression: *P. T. Bauer*. The post-war monetary plans: *D. H. Robertson*. The German war economy, X: *H. W. Singer*.

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*October 1943–January, 1944*—Size of family of the business, professional and titled classes: *A. Spencer Paterson*. Estimates of future populations of various countries: *D. V. Glass*.

#### *Industrial Administration—*

*October 1943*—The mathematics of management: *J. E. Currie*.

#### *Institute of Bankers, Journal—*

*October 1943*—The Hot Springs Food Conference: *W. J. Hinton*.

*January 1944*—Interest rates after the war: *Hargreaves Parkinson*.

*Manchester Statistical Society*, Transactions, Session 1942–43. National income in the United Kingdom and the United States of America: *Richard Stone*. The Beveridge Plan and Local Government finance: *J. R. and U. K. Hicks*. Some essential factors in the evolution of international trade: *A. G. B. Fisher*. Limitations of statistics in the field of public opinion research: *J. G. Ferraby*. The German war economy: *H. W. Singer*. Swedish economic policy during the war: *Karin Kock*.

*Oxford Institute of Statistics, Bulletin—*

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- Education, Board of.* Education Bill. Explanatory memorandum by the President of the Board of Education. London: H.M.S.O., 1943. Cmd. 6492.  $9\frac{1}{4}'' \times 6''$ . 14 pp. 3d.
- Foreign Office.* Agreement for United Nations Relief and Rehabilitation Administration. Washington, November 9th, 1943. (Treaty Series No. 3. 1943.) London: H.M.S.O., 1943. Cmd. 6491.  $9\frac{1}{2}'' \times 6''$ . 7 pp. 2d.
- Health, Ministry of.* Second report of Nurses' Salaries Committee: Salaries and emoluments of male nurses, public health nurses, district nurses, and state registered nurses in nurseries. London: H.M.S.O., 1943. Cmd. 6487.  $9\frac{1}{2}'' \times 6''$ . 51 pp. 9d.
- Home Office.* Registered factories divided into size-groups according to the number of persons employed, 1933–1936. London: Statistical Branch, Home Office. April 1938.  $12\frac{1}{2}'' \times 8''$ . 16 fols.
- Labour, Ministry of, and Scottish Office.* Explanatory memorandum on the draft supplementary pensions (determination of need and assessment of needs) regulations, and the corresponding draft unemployment assistance regulations, dated December 1st, 1943, respectively. London: H.M.S.O., 1943. Cmd. 6499.  $9\frac{1}{2}'' \times 6''$ . 10 pp. 2d.
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- Scottish Office.* Local Government and Public Health Consolidation (Scotland) Committee. First Report. 1943. Cmd. 6476.  $9\frac{1}{2}'' \times 6''$ . 203 pp. 3s. Draft of a local government (Scotland) bill, prepared by the Committee. Edinburgh: H.M.S.O., 1943. Cmd. 6477.  $9\frac{1}{2}'' \times 6''$ . 394 pp. 6s.
- Select Committee on National Expenditure.* Session 1942–1943. Reports: 12th—Central ordnance depots and production of obsolete stores. 5 pp. 1d. 13th—An investigation into certain complaints about a factory near Glasgow. 5 pp. 1d. 14th—War production methods of settling prices for war stores. 108 pp. 1s. 6d. 15th—The salvage of ships and cargoes. 16 pp. 3d. 16th—State-owned assets. 10 pp. 2d. 17th—Replies from departments to recommendations in reports. 36 pp. 6d. 18th—The work of the Committee in session, 1942–1943. 5 pp. 1d. London: H.M.S.O., 1943.  $9\frac{1}{2}'' \times 6''$ . 7 parts.
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- Treasury.* A new system for the taxation of the weekly wage earners. London: H.M.S.O., 1943.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 20 pp. 2d.

## (b) British Empire.

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## (c) Foreign Countries.

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*Instituto Nacional de Estatística.* Taxas de rendimento real, índices de cotações e índices do movimento da Bólsa de Lisboa. Por F. Maia de Loureiro. (Estudos No. 6.) Lisboa: 1943. 10½" x 7½". 88 pp.

## United States of America—

*National Resources Planning Board.* Security, work, and relief policies. 1942. Report of the Committee on Long Range Work and Relief Policies to the National Resources Planning Board. Washington: 1942. 11½" x 9". xii + 640 pp. — 5 folded tables.

*Office of War Information Division of Public Enquiries.* United States government manual. (Revisions through May 15th.) Washington: Government printing office. 1943. 9" x 6". 707 pp. \$1. Presented by Mr. J. N. Paterson.

*Treasury.* Preliminary draft outline of a proposal for an international stabilization fund of the United and Associated Nations. Revised July 10th, 1943. Washington: U.S. Treasury. 1943. 9" x 6". 21 pp.

*United States Tariff Commission.* Foreign-trade and exchange controls in Germany: a report on the methods and policies of German foreign-trade control, with special reference to the period 1931–1939: under the provisions of Section 332, title III, part II of the United States Tariff Act of 1930. (Report No. 150, Second series, 1942.) Washington: 1942. 9" x 6". xi + 293 pp. 35c.

## (d) International.

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The displacement of population in Europe. By Eugene M. Kulischer. (Studies and reports, Series O, No. 8.) Montreal: I.L.O. 1943. (London: P. S. King & Staples.) 9" x 6". iv + 171 pp. (folded tables). 4s.

## League of Nations—

Prosperity and depression; a theoretical analysis of cyclical movements by Gottfried Haberler. Third edition enlarged by part III. Geneva: League of Nations. 1941. 9" x 6". xxiv — 532 pp.

Statistical Year-book of the League of Nations. 1941–1942. Geneva: 1943. 9½" x 7½". 279 pp. 10s.

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- Woytinsky (W. S.). Earnings and social security in the United States. A report prepared for the Committee on Social Security. Washington: Social Science Research Council. 1943. 9" x 6". xiii + 260 pp. \$2.50. Appendix tables i to xxv. 1943. 10½" 8". 41 pp.



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# JOURNAL OF THE ROYAL STATISTICAL SOCIETY

## PART IV, 1943

### SOCIAL SECURITY : SOME TRANS-ATLANTIC COMPARISONS \*

By SIR WILLIAM BEVERIDGE, K.C.B., LL.D., F.B.A.

[Read before the ROYAL STATISTICAL SOCIETY, October 12th, 1943, the PRESIDENT, Dr. E. C. SNOW, C.B.E., in the Chair.]

"SOCIAL Security" is a term of trans-Atlantic origin. The department of Government in the United States which administers what we in Britain should call unemployment insurance and contributory pensions in old age and for widows, orphans and other survivors, was established under the Social Security Act of 1935, and is called the Social Security Board. Three years later, in 1938, the same term was adopted by New Zealand to describe its comprehensive measure of income security for all citizens. Three years later again, in the Atlantic Charter of 1941, the American and British leaders, followed in due course by the Governments of the other United Nations, declared their desire to bring about the fullest collaboration between all nations in the economic field, "with the object of securing for all improved labour standards, economic advancement and social security." Finally, in the report on Social Insurance and Allied Services made by me to the British Government in November 1942, I adopted the term, in proposing a Plan for Social Security to give freedom from want.

Having spent recently two months on the other side of the Atlantic in discussing problems and methods of Social Security, I propose to devote my address to-day to recording some of the principal reflections aroused by this discussion. As a preliminary it will be convenient to explain more precisely the meaning attached here to the term "Social Security."

#### *Meaning of Social Security*

What do we mean by "Social Security"? In paragraph 300 of my Report its scope is described as follows :

"The term 'social security' is used here to denote the securing of an income to take the place of earnings when they are interrupted by unemployment, sickness or accident, to provide for retirement through age, to provide against loss of support by the death of another person, and to meet exceptional expenditures, such as those connected with birth, death and marriage. Primarily social security means security of income up to a minimum, but the provision of an income should be associated with treatment designed to bring the interruption of earnings to an end as soon as possible."

\* I had hoped to be able in this paper to compare British practice and proposals not only with those of the United States, but with those of Canada. Unfortunately, much of the essential material which I collected in Canada and on which I relied, I could not bring with me on returning; it is still in transit and has not yet reached me. The comparisons made in this paper are confined accordingly to Britain and the United States.



This is a description, rather than a definition. In a Pan-American Conference organized by the International Labour Office in Montreal last July, I suggested a definition on the following lines : "Social Security is security for the individual, organized or assisted by the State, against risks which may affect the individual even when the condition of society as a whole is healthy." This definition has several implications :

First, Social Security does not cover directly all measures of economic and social progress, such as maintenance of employment, a minimum wage, public health, housing, nutrition, factory legislation. All these are measures for making the condition of society as a whole satisfactory; they are assumptions of Social Security—some of them specifically named as such in my Report—rather than part of it. However fully achieved, they leave the individual exposed to risks for which he needs provision. The definition implies that the State, that is to say the organized community, in addition to pursuing measures of general application, should take responsibility for ensuring this individual provision.

Second, Social Security, while concerned largely with maintaining income during interruptions of earning, is not confined to income maintenance. It includes the organization of remedial measures for the individual, such as medical treatment, training and rehabilitation, to restore him to health and earning.

Third, Social Security on its income side may cover not only maintenance of income when earnings are interrupted or ended, but provision for exceptional expenses, as at birth, death and marriage. These are "risks" to which the individual is exposed in all societies, healthy or unhealthy.

Fourth, Social Security is wider than social insurance, which is named in para. 302 of my Report as the main, not the sole, method of Social Security, needing to be supplemented by national assistance on proof of need and by voluntary insurance. Social insurance involves compulsion and the giving of benefits as of right when the risk eventuates, without a further test of need or examination of means. In my view also it involves contributions by the insured persons: on that interpretation workmen's compensation for industrial accidents as practised in most countries and unemployment compensation in most of the States of America are not strictly social insurance. As is argued in paras. 24-26 of my Report, social insurance in Britain, in addition to the three characteristics of compulsion, of benefits as of right, and of contribution, is coming to have a fourth characteristic distinguishing it from voluntary insurance and marking it as a new type of human institution. "The term implies a pooling of risks except so far as separation of risks serves a social purpose. There may be reasons of social policy for adjusting premiums to risks, in order to give a stimulus for avoidance of danger, as in the case of industrial accident or disease. There is no longer an admitted claim of the individual citizen to share in national insurance and yet to stand outside it, keeping the advantage of his individual lower risk whether of unemployment or of disease or accident."

Fifth, voluntary insurance is part of Social Security only in so far as the State organizes or assists it, in such ways as those described in para. 378 of subsidizing trade union insurance against unemployment, or para. 379

of promoting special schemes of subsidiary insurance, or para. 382 of taking over industrial assurance. But, as is pointed out in para. 375, the State can promote voluntary insurance negatively by avoiding so far as possible any test of means for its compulsory insurance benefits, and by limiting such benefits to subsistence and primary needs.

When I suggested this definition at Montreal, one of the South American delegates, while welcoming the form of the definition, said that he would prefer to regard it as a definition of "Social Insurance" rather than of "Social Security." The latter term for him included minimum wage and factory legislation, laws authorizing or regulating collective bargaining, and measures to give employment. I answered that I felt the need of a term distinguishing between measures of general application to make society healthy and measures to protect the individual against the risks that would still remain. "Social Security" seemed the best term to use for the latter class of measures as a whole, so that "social insurance" could be used as one method only of Social Security, involving compulsion, benefits as of right and contributions by the insured persons themselves. This is in accord with the nomenclature originally adopted by the United States. There the provision of income during unemployment, being financed in most States by the employers without employee contributions, is described as "unemployment compensation" (on the analogy of workmen's compensation for industrial accident and disease), while the provision for old age and survivors (financed by equal contributions of employees and their employers) is described as "old age and survivors insurance." Both are included in "Social Security." In Britain bodies like Political and Economic Planning, which in giving evidence to my Committee wished to abandon direct contributions by the beneficiaries, also avoided the term "social insurance," as implying such contributions.

#### *Present Position and Proposals in Britain and U.S.A.*

Taking this definition of Social Security, what is the present position in regard to Social Security in Britain and the United States?

In Britain there are three separate schemes of social insurance covering most of the employed population for sickness (1911), unemployment (1911, generalized in 1920) and old age and death of the breadwinner (1925). There is assistance, subject to a means test, in various forms, of which the chief are non-contributory pensions at 70 for those excluded from the contributory insurance, supplementary pensions where the small contributory or non-contributory pensions are inadequate, unemployment assistance for persons exhausting their insurance rights, and general relief administered by local authorities. There is a separate scheme of compensation by employers for industrial accident and disease (1897, generalized in 1906).

The Report on Social Insurance and Allied Services made by me to the British Government in November 1942, as Chairman of an Inter-departmental Committee appointed in June 1941, proposes to combine all these separate schemes in a Plan for Social Security whose main feature is a scheme of social insurance against interruption and destruction of earning power and for special expenditure arising at birth, marriage or death. "The scheme embodies six fundamental principles: flat rate of subsistence benefit; flat rate of contribution; unification of administrative responsibility; adequacy of benefit; comprehensiveness and classification. Based on them and in combination with national

assistance and voluntary insurance as subsidiary methods, the aim of the plan for Social Security is to make want under any circumstances unnecessary" (para. 17). The Plan as a whole on its income side, including social insurance, national assistance and the organization or helping of voluntary insurance, was to be administered by a single department, a Ministry of Social Security, establishing a network of regional and local offices and taking over or using the national system of employment exchanges. Medical treatment was to be administered as part of a comprehensive health service, covering all needs of all citizens, by the departments concerned with health.

This report was debated in February 1943 for three days by the House of Commons and for two days by the House of Lords. The Government declined in the debate to commit themselves to any action on the Report, pending examination of its financial implications and that of other reconstruction plans but, subject to finance, indicated a generally favourable attitude to many of its proposals. Of the six fundamental principles named above they rejected one—adequacy of benefit—and expressed doubts as to another—unification of administrative responsibility. They announced that the proposals of the Report would be considered in detail by the departments concerned. When and how these proposals, or any modification of them, will come before Parliament again is uncertain.

In the United States of America, two of the three main risks, namely unemployment and old age (with widowhood and orphanhood) are provided for under the Social Security Act of 1935. Under this Act the insurance provision for old age and survivors is Federal, while unemployment is dealt with by 51 separate State schemes induced by the Federal legislation and to some extent co-ordinated by Federal supervision. Industrial disability is the subject of 54 separate schemes of compensation under State legislation. Pending the development of adequate contributory pensions, assistance subject to a means test is provided for old age by joint Federal and State action under the Social Security Act which provides aid also for special classes such as blind persons and crippled children. There is no security provision, other than general relief, for sickness and no social insurance for medical treatment.

Very similar proposals for extension and unification of social security in the United States have come recently from three distinct sources:

1. From the National Resources Planning Board, a government organization set up by President Roosevelt shortly after his first election. This Board submitted to the President in December 1941 a lengthy report on Security Work and Relief Policies by its Technical Committee, which was published in 1942. This Report (to which references are made below under the initials S.W.R.P.) gives an extremely valuable description of the facts of poverty and insecurity in the United States, and of the measures taken to deal with poverty; from a critical examination of these measures it leads up to recommendations for their extension and improvement; the Director of Research responsible for most of the technical work on this Report was Mrs. Eveline Burns, formerly on the staff of the London School of Economics and Political Science. With this lengthy technical Report the President, last March, transmitted to Congress also another Report by the National Resources Planning Board which has been published by the Stationery Office in Great Britain as "A Post-war Plan and Program for the United States of America." This Report is much shorter and more general, covering the whole range of economic problems after the war. In my address

to-day I shall be concerned only with the longer technical Report. It should be added that the National Resources Planning Board went out of existence in July 1943, as appropriations for its maintenance were refused by Congress.

2. From the Social Security Board, which, as stated, is the Government Department responsible for the Federal supervision of the 51 State schemes of unemployment compensation, and for the direct administration of the old age and survivors insurance. This Board administers the United States Employment Service (*i.e.*, the national system of employment exchanges).<sup>\*</sup> The proposals of the Social Security Board for development of social insurance are summarized in its Annual Report for 1942.

3. From Senator Wagner, who in association with Senator Murray, introduced in June 1943 a Bill to amend and improve the Social Security Act "to meet the post-war needs of the American people." Senator Wagner is the author of much notable labour legislation in the United States, including the Wagner-Peyser Act, which established the Employment Service in 1933, and the Act which provided for recognition of trade unions.

The nature of the principal proposals emanating from these sources will be described below in dealing with particular problems. They are all on much the same lines.

#### *Differences between the United States and Britain*

Any comparison of Social Security plans between the United States and Britain has to be made in light of certain differences in their economic, social and political structure. Of these the most important from the point of view of Social Security are three.

First, there is a much greater range in standard of living and of many incomes in different parts of the United States than there is in Britain. In 1938-39 the average income per head in the United States was \$536, while that in Great Britain was practically £100. But the income per head in the former country ranged from \$848 a year in Delaware or \$825 in New York and \$753 in California to \$203 in Mississippi with five other States in the deep South of below the \$300 mark.<sup>†</sup> At the time of my visit in the summer of 1943, the wage for day labour in Mississippi was still about \$1.75; at the same time, in the Oregon shipyards, the minimum wage for the least-paid workers, men or women, without any skill at all, was \$1.20 per hour or, counting 48 hours as 52, was \$1.30 per hour—about six times the rate for labour in Mississippi. These differences reflect in part colour differences. Almost exactly half the population of Mississippi are coloured, and the proportions in other States with income below \$300 per head are also considerable. Britain as compared with the United States has the simplification of greater homogeneity.

A second contrast of great importance for Social Security lies in the larger

<sup>\*</sup> The organization of employment offices was at first a State rather than a Federal responsibility. The Wagner-Peyser Act of 1933 providing for Federal grants in aid under the supervision of the Department of Labour led to a great development of these offices and to their co-ordination. In 1939, the Federal supervision of these offices was transferred from the Department of Labour to the Social Security Board, and in December 1941 the service was made directly Federal, by a telegraphic order of the President addressed to all State and Territorial Governors. In September 1942 the Employment Service was transferred from the Social Security Board to the War Manpower Commission.

<sup>†</sup> See Table 68 in S.W.R.P., p. 301.

proportion of independent workers in the United States, particularly in agriculture. In Britain in 1939 of 20.9 million gainfully occupied persons other than housewives, 2½ million or 12 per cent. were in Class II as independent workers. In the United States of America the proportion of independent workers is probably nearly double. In the United States as compared with Britain, agriculture is both a larger proportion of the whole and is conducted more by independent workers; there are twice as many "farm operators" as "farm labourers," and in addition a large class of unpaid "family workers." Moreover, the United States industrial workers remain in many ways nearer to the land, with more possibility of returning to subsistence farming when they are unemployed.

A third contrast is the political one of the division of powers in the United States between the Federal and the State Governments. This is a reflection both of the history and of the geography of the United States, of the relatively recent settlement of the country, as compared with Britain, and of its immense size.

### *Survey of Poverty in the United States*

The value of the Technical Committee's Report on Security Work and Relief Policies lies not so much in its recommendations (though these are supported by able reasoning) as in its analysis of the facts of poverty and insecurity in the richest country of the world. A few illustrations will suffice:

*The scale of the problem.*—From 1932 to 1940 the estimated numbers unemployed in the United States ranged from a minimum of 5,066,000 in September 1937 to a maximum of 14,762,000 in March 1933, exceeding 10,000,000 on an average in each of four years of the period 1932, 1933, 1934 and 1939. The March 1933 maximum is stated to represent 29 per cent. of the labour force; the September 1937 minimum was apparently about 9½ per cent. These figures are estimates, not direct counts of unemployed persons, such as those provided for Britain through the administration of unemployment insurance.\* But the estimates cited here—those of the National Industrial Conference Board—are generally lower than those put out by other authorities. And they probably understate the total loss of employment, since they do not include partially employed and short-time workers.

Another indication of the scale of the problem of poverty is provided by giving total numbers receiving aid of some kind under some or other of the various programmes for relief, whether by work or by money. "Between January 1933 and June 1940, the various public aid programmes assisted an estimated total number of households ranging from 4,100,000 to 8,000,000 a month. The total number of persons included in the households ranged from 13,500,000 to 28,100,000."† "It is reasonable to estimate that no less than 35 per cent. of the total population, or every third person, was aided by some governmental measure at some time between January 1933 and June 1940."‡ These figures include persons aided by work put in hand through the Work

\* The starting point of these and other estimates of unemployment in the United States in the decade 1930–40 is the census of 1930 giving the total labour force and the numbers then unemployed. "Estimates of unemployment for subsequent periods are then secured from the difference between the estimated changes in the total labour force and the estimated changes in the volume of employment." See S.W.R.P., pp. 19–20 and 552–56.

† S.W.R.P., p. 98.

‡ S.W.R.P., p. 100.

Projects Administration. To be eligible for such work persons had to be certified by appropriate local agencies as being "in need of employment," and preference for such employment was given on the ground of having no income or an insufficient income, that is to say by a means test.

*The persistence of the problem in the past.*—There is a curious echo of British experience in some of the figures of chronic unemployment. "Of the 2,199,700 unemployed workers who registered for the first time with the United States Employment Service from July 1936 through March 1937 almost one out of three (32·3 per cent.) had been out of work six months or longer. Nine per cent. had been unemployed for at least four years."\* There is another parallel in the existence of special areas where for one reason or another distress has become the normal condition. One of the most striking features of the Report is a map of the United States (on page 107) showing by counties the proportion of the total population receiving emergency relief in the year from July 1934 to June 1935. The counties coloured black, because this proportion was 30 per cent. or more, cover large blocks of both the Dakotas, Utah, Colorado, New Mexico, Oklahoma, Idaho, Michigan, Kentucky and West Virginia. The map relates directly only to a single fiscal year, 1934-35, but "many of the counties with the highest relief population in that year still presented serious public aid problems in 1940."† In the main, these depressed areas mark places where mining and lumbering resources have been exhausted and agriculture is unprofitable, that is to say they are mainly rural areas. But chronic depression is not confined to rural areas. The Report observes that "the apparently chronic depression in many urban areas has not been so well publicised" as that of the rural areas, "but it is highly significant."‡

*Unemployment among the young.*—The fact that in certain parts of Britain even young adaptable people could find no employment and the disastrous effects upon them of prolonged idleness has been one of the worst blots of our record between the two wars; in the United States also "the difficulty of youth in finding jobs has emerged as one of the most serious problems of the depression. It is estimated that youth constituted a third of all the unemployed during the thirties and that at least one-third of all employable youths were unable to find jobs."§ "The relative severity of unemployment among young people is confirmed by numerous State and local censuses and surveys." "In Michigan 39·0 per cent. of the approximately 70,000 youth of 15 through 24 years who were unemployed in January 1935 had been out of work for at least one year prior to that date. In fact 18·4 per cent. have been unemployed for three or more years. A study of 21,000 youth in seven widely scattered cities revealed that of the 4,000 youth unemployed on July 1st, 1938, 28 per cent. had been continuously unemployed from six months to one year, 22 per cent. had been out of work a year or more, and 5 per cent. had been unemployed for more than three years."|| These records of where youth stands in free democracies in times of peace are in poignant contrast to what is required of youth in war. It is perhaps not unnatural that the American Congress during the present year should have abolished as unnecessary the New Deal agencies for dealing with unemployed youth. The State has other uses for the young in war and they are not unemployed. But what is to happen when peace returns? The difficulty

\* S.W.R.P., p. 21.

§ S.W.R.P., p. 21.

† S.W.R.P., p. 107.

|| S.W.R.P., pp. 258-60.

‡ S.W.R.P., p. 106.

of youth in finding and forcing its way into the economic system is the crowning mark of restrictionism. The older men and women, established in their jobs, cling to them; the door is shut on growth, change and adventure.

*Probable future persistence of the Public Aid problem.*—One of the points which in explanation of my Report for Britain I have to make again and again in face of misunderstanding, is that the Report is not in the main concerned with unemployment, but with other causes of poverty. This point finds an exact echo in many statements of the Technical Committee's Report for the United States. "The most striking fact revealed by this analysis is the relatively large proportion of the public aid population whose dependency is not directly related to changes in the total volume of unemployment. Almost two-fifths of the households in receipt of public aid in June, 1940, contained no employable member." \* Not all the other three-fifths "would be removed from the public aid category if the state of full employment were attained." First, there will still be frictional unemployment "as the price paid for a flexible system of production." The Report cites expert estimates that even with full employment frictional unemployment might run as high as 5 to 8 per cent. of the available labour supply. This on June 1940 figures would mean from 2½ to 4½ million unemployed. Second, there are employable workers disadvantaged by various forms of inferiority whose permanent absorption in regular employment is doubtful. The Report puts these at from 680,000 to 850,000 in June 1940. Third, some families require aid even with a member in full employment where the wages are low or the family particularly large.† "These various considerations suggest that even if full employment could be achieved, the number of households in need of public aid would be unlikely to fall below half of the number receiving aid in June 1940." ‡ This number of households was about 7 million, representing 20 million persons (exclusive of recipients of workmen's compensation and one or two other special classes). That is to say, the Report of the Technical Committee looks forward, even with full employment, to a public aid population in the United States of 10 millions. It remains only to add that of the recipients of public aid in June 1940, the vast majority (about 82 per cent.) received aid only subject to proof of need, that is to say on a means test.

#### *Place of Unemployment Insurance in Social Security*

The definition of Social Security suggested above has a dialectical advantage. In distinguishing between measures of general application to make the economic and other conditions of society as a whole healthy and measures to safeguard individuals against risks to which they will remain exposed even in such a society, the definition raises the question of what those risks are. The question arises most pertinently in respect of unemployment. Can a society in which men able and willing to work are unable to find work be described as healthy? Is social insurance against unemployment an integral part of social security, or is it a confession of failure?

The first point to note in answering this question is that, as compared with other forms of social insurance, compulsory State provision for unemployment, whether by way of social insurance or of compensation, is relatively rare. Of the 31 countries as to which comparative information was furnished by the International Labour Office to the Inter-departmental Committee on Social

\* S.W.R.P., p. 130.

† S.W.R.P., pp. 131-2.

‡ S.W.R.P., p. 133.

Insurance,\* nine only are recorded as making such provision. Five of these nine were parts of the British Commonwealth (Britain itself, New Zealand, Queensland, South Africa and, since 1940, Canada). One was the United States with unemployment compensation under the Social Security Act of 1935. The three others were Bulgaria, Hungary and Poland. These were not the only countries which included provision of income in unemployment as part of Social Security as defined above; State subsidies to trade unions or other associations providing unemployment benefits were found in Denmark, France, Belgium and elsewhere. But compulsory unemployment insurance organized by the State is a British invention, as insurance against unemployment in its earlier form of trade union benefit had been a British invention. Germany, which had pioneered in the field of social insurance against sickness and invalidity in 1887, did not establish compulsory unemployment insurance till after the first World War, and abandoned it under the Nazis. The Soviet Union at one time included unemployment benefit in its security scheme, but this was dropped in 1930 on the ground that there is no unemployment. Countries like Sweden or the States of Latin America, which regard themselves as deeply interested in Social Security, have no State insurance for unemployment.

In contrast to this view, unemployment has bulked so largely both in Britain and in the United States that there has been a tendency in some quarters to discuss plans for Social Security, as if they were wholly or mainly concerned with unemployment and with keeping fit people in idleness. This, of course, is wide of the mark. In each country provision for unemployment is a small part, and is likely to be a diminishing part of the security programme. But it is sufficiently important in each country to make worth while a special comparison of what is now done and what is proposed in that field.

In the United States as has been said there are 51 separate schemes of unemployment compensation in the States and territories, established under State legislation but induced in most cases by Federal action. The Social Security Act of 1935 imposed a pay-roll tax of 3.0 per cent. on employers, but allowed any employer exemption from all but 0.3 per cent. if he could show that he was contributing to a satisfactory State scheme. This naturally induced each of the States to establish a scheme of compensation, as otherwise their employers would have paid the whole tax without getting any advantage from it for the employees. No two of the 51 schemes are identical, so that very few statements hold true of all of them. But the schemes are broadly similar and present interesting contrasts with British practice.

(1) The proportion of the working population covered is much less. It is estimated that in 1940 about 28 million were covered out of a total labour force of 54 million. As compared with Britain, the principal classes omitted are (a) persons employed in agriculture, merchant shipping or by governmental or non-profit making agencies, and (b) persons in the service of small employers (those with less than 8 employees are exempted in 25 States, but in some of the most populous States—New York, California, Illinois, Massachusetts—the exemption limit is lower at 5 or 6 employees). Only six States cover employees regardless of the size of the firm.

(2) The cost in most States is borne wholly by employers, through a pay-roll tax, with no contributions by the employees or the general tax-payers. The

\* See Appendix F to the Report.



amount of the State pay-roll tax, though fixed generally at 2·7 per cent., may be adjusted by "experience rating," that is to say, according to the amount of unemployment experienced. The laws of 39 States provided for experience rating in 1940, but at that time experience rating was operative in 4 only of these States. Since 1942, its operation has been extended greatly, and by August 1942 it was effective in 38 States. This is presumably in part a reflection of the high level of employment in war; in nearly all cases experience rating has meant a reduction, not an increase, of the pay-roll tax.

The desirability or the reverse of experience rating is the subject of very vigorous discussion in the United States. Its prevalence provides a striking contrast to the development of public opinion in Britain against varying the premium with the risk in social insurance.\*

(3) The rate of compensation provided is geared to the wages earned by a benefit formula "intended to relate a worker's benefit rights mathematically to his previous earnings experience." The actual formula differs in every scheme. "In effect, most of the laws fixed the weekly benefit amount for total unemployment at about half the weekly wage that a worker would receive when employed full time," subject usually to a minimum (commonly \$5 a week) and to a maximum (commonly \$15 a week).† There are no dependent allowances except in one scheme, that of the District of Columbia.

(4) Eligibility for benefit is confined to persons who have earned minimum sums or had a minimum amount of employment in a defined period preceding the benefit application. The conditions for eligibility vary from State to State. It is estimated that taking the country as a whole, about 17 per cent. of all nominally "covered" workers were ineligible for benefit in 1940, but the proportion in 13 States was 25 per cent. or more.‡

(5) The duration of benefit is much less than in Britain. The period of benefit is cut down at the beginning by a waiting time, which is usually either one week (21 States) or two weeks (27 States) or in some cases three weeks. The period of benefit is limited at the other end by the benefit formula, which in most States makes the period of benefit vary from individual to individual subject to a maximum which may range from 13 to 26 weeks, but is commonly 16 weeks. In about one-fourth of the States the duration of benefit is uniform for all qualified applicants, being fixed at 13, 14 or 16 weeks.§

Taken as a whole, the American scheme represents a very much less complete provision for unemployment than the British one. In introducing his Bill, Senator Wagner included the following statement:—

"About half the working population in peace-time was not covered by State unemployment insurance laws. Therefore about half the returning soldiers will have no benefit rights at all. As for those who are eligible, it should be realized that benefits are utterly inadequate, do not grant dependents benefits and do not cover wages lost by illness. In 1940 and 1941—fairly good years—half the beneficiaries of State unemployment insurance laws were still without a job when their limited benefit rights were exhausted."

\* See paras. 24–26 of my Report. Most of those who wish to develop Social Security in the United States—e.g. the Social Security Board and the National Resources Planning Board—oppose experience rating but it is strongly favoured by employers.

† S.W.R.P., p. 69.

‡ S.W.R.P., p. 212.

§ S.W.R.P., p. 70.

The making of inadequate provision only for income during unemployment in the United States is deliberate. Senator Wagner himself, while desiring to lengthen the duration of benefit, does not propose to make it indefinite. He names as one of the differences between his Bill and my Plan that his Bill "puts definite limits on the duration of insurance benefit for unemployment, temporary disability and hospital care." Whereas provision of an income by insurance with its outgrowth of assistance has been the sheet-anchor of British policy in dealing with unemployment between the two wars, the main emphasis in the United States has been always on the provision of work in some form or other, first through the short-lived Civil Works Administration in 1933-34, later through special programmes under the Federal Emergency Relief Administration, and from 1935 to 1940 through the Work Projects Administration.

The differences between the United States and Britain in the treatment of unemployment as a Social Security risk are substantial, but less important than their agreement. In both countries it seems certain that unemployment insurance will continue to be an integral part of Social Security. This is not merely because, as a practical matter, in progressive, changing communities unemployment, though it may be reduced to interval unemployment, is not likely to be abolished altogether. It is also because insurance against unemployment is an instrument for maintaining the independence of the employee, so that he does not depend upon continuing to satisfy implicitly the demands and requirements of his employer, whether private or public. Nor is the difference between the benefit unlimited in time that is proposed in my Report and the limited benefit proposed by Senator Wagner really fundamental; for both countries the assumption is that mass unemployment will be avoided, so that chronic unemployment will become exceptionally rare. For Britain under my Plan, as for America, it is contemplated that these exceptional cases of chronic unemployment will be dealt with not merely by provision of an income, but by provision of occupation, by way of training and rehabilitation.

The real significance of my proposals in regard to unemployment is to reduce the relative importance of unemployment insurance in Social Security as a whole. The total Social Security Budget after the Plan has been in operation 20 years as set out in paras. 26-28 of the Report is estimated at £858 million. Of this total unemployment benefit accounts for only £107 million, or one-eighth. This is little more than the actual amount spent on unemployment benefit and assistance before the war, when the rates of benefit were materially less. The assumption of my Report is that unemployment can be materially less after this war than it was during the thirties, and the intention is to rule out as contrary to public policy the practice which established itself between the two wars of dealing with chronic unemployment by mere provision of income.

In paragraph 440 of my Report five reasons are set out for Assumption C of the Report, that is to say, for saying that a satisfactory scheme of social insurance assumes the maintenance of employment and the prevention of mass unemployment. One of these reasons so much outweighs all the rest that it might well have been left to stand alone: the guarantee of an insurance income is suitable provision for short unemployment, but utterly inadequate for prolonged unemployment. I am sometimes asked to-day what changes I would make in my Report in the light of comments on it since it was published nearly a year ago. So far as I can see, up to the present, the two most important changes that I should want to make are both omissions. In para. 440, in order

to emphasize the one fundamental reason for Assumption C, I should omit altogether the fifth reason given there: that with mass unemployment the cost of Social Security might be excessive. In the thirties we had mass unemployment, but could easily have afforded, by wise distribution of income, to abolish want. Wise distribution of income, so as to put first things first, does not in real terms cost anything. If I had realized to how much misunderstanding, some genuine, some deliberate, the last reason named by me in para. 440 would give rise, I would have left it out. My second change today would be omission of the bracket placed round my proposal to convert industrial assurance into a public monopoly service to mark that proposal as not essential to the Plan as a whole. Fair treatment for all is essential to the Plan. Concessions to one sectional interest weakens the impetus of the Plan in dealing with other sectional interests and in securing the interests of the community as a whole.

But that is another story. The answer to the question at the head of this section is that for a free dynamic society unemployment insurance to guarantee income during short intervals of unemployment is an integral part of Social Security. Unemployment insurance as a means of palliating mass unemployment is a confession of failure.

#### *British and American Proposals Compared*

As is stated above, very similar proposals for development of Social Security in the United States have come from three distinct sources: the National Resources Planning Board (now defunct), the Social Security Board and Senator Wagner. What prospect any of these proposals have of receiving early practical consideration by Congress it is impossible now to say. The answer to that question is subject to the uncertainties of war and of an election campaign. But the interest shown in my Report in the United States suggests that, as soon as the time is ripe, the giving of greater social security is likely to become there an important practical issue, and makes it of interest to consider the main features of the proposals that are made for development of the social services.

For this purpose, it will be sufficient here to take Senator Wagner's Bill. The object of this Bill as summarized by its author is as follows:

"The Bill establishes a nation-wide system of public employment offices, to help war workers and war veterans to avail themselves of job opportunities, in private industry and on farms, throughout the country. It covers broadly the major economic hazards of average American families—the cost of medical and hospital care, and loss of income in time of unemployment, temporary sickness, permanent disability and old age. It improves the present old-age insurance system, and extends coverage to 15,000,000 persons now excluded, such as farm workers and domestic servants, employees of non-profit institutions, and the independent farmer, professional and small business-man. All these changes are established under a unified national system of social insurance with one set of contributions, one set of records and reports, and one set of local offices. Re-inforcing the job guarantee in the Selective Service Act, the Bill gives the returning veteran and his family paid-up benefit rights in every phase of this insurance protection. And finally, the Bill sets up an improved, unified system for grants-in-aid to the States for public assistance on a variable matching basis, in place of the rigid categories under the present law."

The scope of this Bill is obviously similar to that of my Report on Social Insurance. It fills the main gap in the existing structure of Social Security in the United States—lack of provision either of income or of treatment in sickness. It makes social insurance so far as possible comprehensive in respect of persons and unified in administration: this unification means both combining the different risks, such as unemployment, sickness, old age—and making administration Federal. Finally, while leaving responsibility for public assistance, that is to say, relief as distinct from insurance with separate States, the Bill aims by a revised system of grants-in-aid at attaining much greater uniformity in practice.

Senator Wagner's Bill is a programme similar to the Plan for Social Security in my Report. It embodies at the same time important differences, summed up by Senator Wagner himself under four main heads. These heads are set out below with comments on each of them.

*"First, the Beveridge plan puts more than half the cost upon the General Treasury in the very first year of operation. The social insurance plan under this bill is financed at the outset by equal pay-roll contribution of employers and employees, except for the payments into the fund by the Treasury to cover the insurance rights of war veterans. I, personally, favour a substantial Government contribution into the social insurance trust fund, but appreciate that the Treasury cannot carry this burden now on top of its war and immediate post-war needs. This bill therefore contemplates Government contribution into the fund, beginning after a period of perhaps 10 or 15 years, and increasing gradually until it represents about one-third of the total, when old-age benefits paid out reach their maximum under present population trends. To maintain flexibility, however, the bill directs the advisory council to study the entire problem of financing in the post-war years."*

This comment throws into relief the striking difference between the present methods of financing Social Security in the two countries, and at the same time marks the tendency of reformers in the United States to come nearer to the British model.

In Britain, social insurance has been established for more than 30 years on a tripartite scheme of contribution, with the insured employee, his employer and the general taxpayer contributing in varying but comparable proportions in all schemes. A very substantial contribution has always come from the general taxpayer, and my Report would increase this proportion. Very roughly the contributions of the insured persons themselves will meet about a quarter of the cost of the cash benefits, those of the employers will meet rather less than a quarter and more than half will be paid by the tax-payer. Moreover, there are many serious students of this problem in Britain who argue that the whole cost should be borne by the tax-payer, and that direct contributions either by the employer or by the employees represent a regressive undesirable form of taxation not according to capacity to pay, which should now be abandoned. Though, for the reasons set out in paragraphs 272-6, my Report rejects this argument, the intellectual weight of the argument is undoubted, and it receives support from the practice of New Zealand, where Social Security is financed wholly by special income tax.

This makes the more striking the very different line adopted hitherto in the United States, where the whole cost of Social Security has been borne either on

paid by the employers (for unemployment compensation), or by the employers and employees jointly (old-age and survivors insurance) without any contribution whatever by the general tax-payer. The political reason for this lies probably in the limitation of the classes to which security has been extended hitherto, and in the relatively large proportion in the United States of independent workers who would probably object to contributing as tax-payers to security schemes by which they would not benefit. It is the essence of the New Zealand scheme that security should apply to all citizens, and not to particular classes.

While there is at present this marked distinction between the United States and Britain in respect of Social Security finance there is also now a significant tendency by those who wish to develop security in America to approach the British model.

In place of the present system, whereby unemployment compensation is provided wholly by employers, and old age and survivors insurance is financed by equal contributions of employers and employees, without any contribution in either case from general taxation, Senator Wagner proposes joint equal contributions for all purposes by employers and employees with ultimately a substantial Government contribution. The National Resources Planning Board do not appear themselves to make any definite recommendation as to methods of financing Social Security. But the Report of the Technical Committee leads up to a tripartite scheme of contribution. It recommends "that a proportion of funds needed for social insurance programmes should be derived from general tax-revenues." It gives reasons for retaining wage and pay-roll taxes as at least a partial source of revenue for the social insurances, "despite their evident social and economic disadvantages." These reasons include:—

(a) The value attached by the public to getting benefit without means test. If such benefits are to be restricted to certain classes only, the best defence of restriction is that the recipients have contributed.

(b) The fiscal attractiveness of such richly yielding and hitherto unutilized taxes.

(c) The direct linkage of benefits with contributions "offering at least some measure of control over organized lobbies for excessive liberalization of benefits." \*

These reasons, it will be seen, are substantially the same as those advanced in para. 272 of my Report for retaining insurance contributions, in place of financing security wholly by taxation.

*"Second, the Beveridge plan provides the same contribution and the same benefit for all classes and groups, with variation only as to sex and number of dependents. This Bill follows the traditional American system of gearing both contributions and benefits to past wages, as well as dependents. The Bill thus automatically adjusts to different standards of living wage scales and family needs of workers in different sections, States and industries throughout the country."*

The American plan of gearing benefits and contributions to earnings in place of aiming at a flat rate is a natural consequence of the much greater variation of money incomes and standards of living in different parts of the country than is found in Britain. It reflects also the fact that social insurance, as a later growth

\* S.W.R.P., pp. 523-24.

in the United States than it is here, has not yet shed so completely the ideas appropriate to voluntary insurance.

As is made plain in my Report in the paragraphs discussing benefit rates and the problem of rent (paras. 193–216), the possibility of adopting throughout Britain a uniform flat rate of subsistence benefit depends upon the assumption that costs of living in different parts of the country are or can be made reasonably uniform. This is probably true now for most parts of the country in respect of necessities other than rent. In respect of rent it is not now true. In paras. 214 and 215 it is suggested accordingly that the practicability and desirability of differentiating benefits and contributions regionally and occupationally, so as to cover on the one hand the exceptionally high rents of London and similar districts and to avoid on the other hand excessive allowance for rent in country districts, should be further examined. This slight concession to variation of rates and benefit contribution is, however, different in principle from the general gearing of rates to individual earnings which is the basis of the American system.

Some variation of benefits by earnings is clearly indispensable in a country with such varying standards of income and living as the United States. Indeed, the flat-rate system is very rare outside Britain itself and New Zealand. Most European countries have followed the German model of grading contributions and benefits by wage classes, and this is the plan adopted in Canada for unemployment insurance. The United States goes a step further than other countries in differentiation, in so far as it relates benefits and contributions to individual earnings. The amount of these determines not only the rate of unemployment compensation in all cases, but in many cases determines also the duration of compensation. The general effect is to keep the social insurance scheme nearer in principle to voluntary insurance and at the same time to make it less effective as a guarantee against want. Those who, through special liability from unemployment or sickness, are in most need of benefit get least benefit; those whose low wages make it hardest for them to make private provision for old age get least as contributory pensions.

*“Third, the Beveridge plan provides a guaranteed minimum income for life. This bill puts definite limits on the duration of insurance benefits for unemployment, temporary disability and hospital care.”*

This difference illustrates the fact that even those who wish greatly to develop Social Security in the United States, as Senator Wagner does, do not feel able as yet to go the length of taking assured freedom from want as their aim. If one really means to assure freedom from want one must provide benefit adequate in amount and adequate in time, that is to say benefit lasting as long as the need lasts. Even the most progressive public opinion in the United States is probably not ready for this. The battle of social insurance in Britain was fought and won more than thirty years ago. In the United States it was inevitable that recognition of economic insecurity should come later and should still be less complete, because of the later industrialisation of the United States and of its higher level of productivity. It is natural that there should still be less general acceptance of the need for social insurance. Senator Wagner's Bill is a measure greatly to improve the existing provision for social security, rather than a Plan for abolition of want. Under the Wagner Bill, so far as sickness is concerned, since some cases of sickness will undoubtedly last after benefit has been exhausted, limitation in time both of benefit and of treatment

means that the sick person will then be thrown back upon relief. It may be assumed that he will have exhausted his resources. So far as unemployment is concerned as has been shown above, the difference between Senator Wagner's policy and that of my Report is formal rather than substantial. It is of the essence of my proposals that, by the adoption of an adequate full employment policy, prolonged unemployment should be made rare, and, further, that in those rare cases provision of income in unemployment should be accompanied by provision of training or occupation. In practice what should happen in the two countries is much the same. In theory, there is the difference that my proposals place upon the community the responsibility to support those whom it cannot occupy in useful employment, provided that they are willing and fit for such employment.

*"Fourth, this bill does not cover many matters embraced in the Beveridge plan, such as provision for workmen's compensation, grants on marriage and birth of children, children's allowances, dental care, nursing, or medicines in the home."*

Of the various omissions from Senator Wagner's Bill of what is contained in my Plan, the most important is children's allowances. While most American proposals for development of security now contemplate allowances for dependence as an addition to benefit, the question of children's allowances to be paid in times of earning as well as in times of not earning has hardly yet risen above the horizon of discussion. The higher level of wages generally and the lesser urgency of need to increase the birth rate in order to maintain the population make it unlikely that in the near future the problem of children's allowances will come to the forefront in the United States. It is interesting, however, to note that in Canada children's allowances are definitely proposed in the Marsh Report.

The other main difference of scope is that Senator Wagner proposes to keep workmen's compensation as at present—the subject of 54 different schemes under State legislation. At the end of December 1938 one State (Mississippi) was still without a workmen's compensation law. All the schemes between them covered only 17 million persons, less than half the employed population. Agriculture and domestic service were almost everywhere excluded. Small employers (usually those with less than 3, 4 or 5 employees, though in Alabama the limit was as high as 16 employees) were excluded in 28 States. Occupational disease was covered directly only in 30 schemes; it is covered to some extent indirectly in other schemes by treating injury which results from disease as accidental injury. The form of the provision was generally as in England—a liability on the individual employer to pay as compensation a percentage of the wages earned subject to a fixed maximum and minimum, though four Western schemes (Oregon, Washington, Wyoming and Alaska) required fixed payments not related to wages. Most of the schemes went beyond British practice in removing administration from the Courts to an administrative Commission or Board, and a substantial number (22 out of the 54) made it compulsory for employers to insure against their liabilities. All schemes, again, went beyond the British law in providing medical aid of some sort, but in the view of the Technical Committee "there was considerable evidence that the provision of medical treatment was, in general, far from adequate." \* A curious feature, from the British standpoint, is that in 32 of the schemes the compensation

\* S.W.R.P., p. 85.

laws are elective—that is to say, it is open to employees and to employers either to accept or to reject the Act; rejection by the employer involves as a rule that he is debarred from using the customary common law defences, such as the doctrine of common employment, in a civil action. The various schemes thus briefly summarized, though some of them in some ways go beyond present British practice, in other ways, notably in scope, fall far short of British practice. This can hardly be regarded as so adequate a provision for industrial disability as to need no change. It is perhaps reasonable to believe that Senator Wagner's omission of workmen's compensation from his Bill had a mainly tactical motive—of not stirring up too many tigers at one time.

#### CONCLUSION

It will, I hope, be obvious from what has been said above that comparative study of the problems and methods of social security in the United States of America and in Britain is of peculiar interest. In most ways the two countries are more like one another than any others, except other parts of the British Commonwealth. Each of them is highly industrialized, and industrialization leads to a high national income per head. This makes the problem of freedom from want in each, not mainly a question of wages, but of the distribution of income between times of earning and not earning. Industrialization in each country has brought, as one of its by-products, unemployment in its various forms: interval, structural and cyclical. It has made the overcoming of cyclical fluctuation and the adoption of a full employment policy a fundamental aim for each country. The two communities are alike also in the resolute independence and individualism of their citizens: they are and will remain dynamic, free societies. Plans for Social Security in the United States and in Britain alike must be conditioned by their individualism.

There are, of course, differences of conditions between the two countries. Some of these have been named already: the greater variety of standards of income and living in different parts of the United States; the larger proportion of independent workers there; and the division of responsibility between Federal and State Governments. More important than these is a difference of attitude to Government. In Britain, in spite of the resolute independence of the individual citizen, there is less fear, on the whole, of Government and Government machinery for the achievement of social purposes than there is in the United States. The British democracy, though it professes to regard politicians with amused tolerance and bureaucrats with aversion, is not really afraid of either. In the United States it is not always easy for the British visitor to escape the impression that the free citizens of that great country still regard all Governments as their ancestors regarded the Government of George the Third, and that they do not realize sufficiently that the British revolted against the ways of George the Third as effectively as the people of America, if slightly later. I believe myself that, through this different attitude to Government, as well as through the greater homogeneity and smaller size of the population, the attaining of freedom from want is easier in Britain than in the United States, in spite of the higher productivity per head and the larger natural resources of the latter country. But freedom from want should be within the early grasp of each of these peoples. It will come sooner to each through mutual study of their common problems in this field.



## DISCUSSION ON SIR WILLIAM BEVERIDGE'S PAPER

SIR GWILYM GIBBON: It is my privilege to propose a vote of thanks to Sir William Beveridge for his paper. The Society is fortunate in having this paper from one who is soaked in his subject, so soaked that it almost oozes out of his finger-tips. The paper has a special interest for me because I have kept in close touch with social developments in the States now for many years, and very interesting and exhilarating I have found it.

When I was over there in 1926, I was asked many questions about the dole, and whether Britain was losing its grip, with the answer usually contained in the tone and terms of the question. When I was there in 1932, I was asked many more questions about the dole, now raised to the dignity of unemployment insurance—what it covered, how it was administered and the like. Indeed, the zest for information even surpassed the zest for hospitality, which is saying much for the States, and more than one tempting meal was only partly consumed by the victim, the questioned. It was on that occasion, too, that I stood with a well-known professor on the campus of one of the big universities, watching the students for a new term scurrying to and fro, and asked him what was the justification for bringing there all these young men and women and what were they to receive; he turned to me with a characteristic twinkle and smile and replied, "There are worse forms of unemployment pay"!

Incidentally, I think that Sir William will find that the body which was transformed into the National Resources Planning Board was first appointed under the Hoover, not the Roosevelt, regime.

I am glad that the diversity of conditions in the States was emphasized. It is on an European scale, far beyond that of our tight little island. So, too, is the diversity of administration. You might find two institutions, almost cheek by jowl, the one in some respects excelling anything in this country, the other below anything that would willingly be tolerated here. The reason is partly that the States rely much more on personality and much less on rule and control than we do. And, while rule and control may provide a floor below which administration is not allowed to sink, it may also indirectly provide a ceiling above which it is not allowed to rise. This is a subject worth developing, but not here. I may add that the standard of administration also differs greatly among the States, and in some of them is—shall I say, sometimes more than a little odd.

I have a grouse against Sir William for borrowing the term "social security" for his proposals. The States are somewhat given to attractive labels. I think the term does some violence to the English language: it sometimes takes a Welshman, or a Scot, to protect the language!

The objection, however, is substantive, not just academic. There is much more to social security, in its broad and proper sense, than the proposals, not least the prevention of mass-unemployment, to which Sir William is now directing his attention. "Social security" in the narrow sense is in the main no more than preservative. We shall not win prosperity from the difficult conditions of the post-war years without abundance of the creative, in initiative and enterprise, ingenuity and adaptability. I could illustrate this from what happened in the States, if there were time. [I had in mind the decision of big motor manufacturers, when the hoped-for revival did not mature during the great depression, to try creating their own market. For this purpose they boldly remodelled their works out of reserves at their disposal and produced cars far superior to the pre-war and at a lower price, cars so attractive that they pulled money out of reluctant pockets and started a stream of demand which, spreading to other channels, fructified industry all over the country. This enterprising decision probably did more than any other act, governmental or other, to turn the tide. I mention this not to praise private enterprise, but as an instance of creative initiative.]

I fully recognize the need for much more in the preservative sphere, for social security in the narrower sense, but I deplore the relatively little attention given

to the creative necessities, upon which even this narrower social security will chiefly depend, and much else besides. I hope that the investigation into means for preventing mass-unemployment will do something to redeem the balance, but much more is required.

It was natural for the States to turn to work relief when the economic storm burst upon their unsuspecting heads. Quite apart from the absence of any other general or systematic provision, the problem which faced the country was that of mass-unemployment. Works were set going of many kinds, with, I am afraid, rather sorry results as a whole: which was to be expected, for they had less experience than ourselves, and our record is not a matter for much pride.

Some good results were obtained. The most paraded here is the Tennessee Valley scheme, which has received much praise from persons who, however eminent in their own spheres, usually appear to have no special competence in matters of engineering, which may be significant. The scheme is in fact very involved, including flood prevention, improvement of navigation and some smaller matters, and the finance is the most involved of all. No judgment is worth two pinches of salt unless based on thorough, impartial and highly competent investigation.

The most astute scheme of which I am aware is that carried out by Commissioner Moses in reclaiming large stretches of land in the New York region, some of which accommodated the Great Fair, with later reversion to public ownership for parks and the like, and in making splendid highways, all with liberal Federal subsidies.

There is much else that is tempting, but I must end with one more comment. I should like to endorse most heartily the close of the paper with its plea for mutual study. In social insurance, for the present the States have more to learn from us, because, when all is said, their developments in this field have been scraggy. But in other matters we have much to learn from them, and still more as time goes on. They approach these social problems with somewhat fresher minds; they are bolder in venturing, though at times strangely timid; they still have much of the frontier temperament, where the world is young for man's making. It is to be earnestly hoped that the close relations which have developed for war will grow still closer for the not less testing problems of peace; mutual study can make a notable contribution towards good handling of our common tasks.

I have much pleasure in moving a warm vote of thanks to our past President.

SIR WILLIAM ELDERTON: The Society has strange habits. The Council chooses for a vote of thanks someone suspected to be in disagreement with the author, and I am the victim of this custom to-day. I console myself with the thought that concealment of disagreement endangers an old friendship more than confession—especially if I surrender myself to Cromwell's suggestion and think it possible I may be mistaken. Writing to me a few months ago about the Beveridge Report, the Planning Board and the Marsh reports, an American actuary expressed the view that perhaps the most important things to watch in such programmes were, (1) the level of benefits, which has to be kept low enough so as not to tempt more people into a benefit receiving class, and (2) the general community attitude on personal responsibility, which, once dead, is hard to revitalize.

Let me refer to the first of these things. Danger in the level of benefits is more likely when there is a level contribution and a scale of benefit that does not depend on income, than in the American system, when contribution and benefits are linked to earnings. The Beveridge suggestions extend existing British practice, but I gather that, with the wide variations in earnings and needs in different parts of America, he would regard the American system as better suited to that country. They have another complication. They are largely governed through State rather than Federal legislation. More than fifty different schemes for unemployment and workmen's compensation seem strange to us, but so far

as the latter is concerned there is probably another reason besides those mentioned in the paper, because common law rights differ in different States.

I am not convinced that, over the whole of England, Scotland and Wales, variations in needs are negligible but, any way, the variations are much less than in America.

Everyone can see that there are difficulties in applying universally one scale and one system to classes that differ so widely as the clerk with a fixed salary, the piece-worker and the many different kinds of nurse. With two of these I have had personal experience and, while appreciating his difficulties, I regret the Beveridge recommendation that the special schemes evolved for those in insurance, banking and finance should go. He also regrets this; perhaps he would not value highly the palliative mentioned in para. 378 of his Report any more than I do. Nurses, as he admits, raise a difficult problem; I think they call for special treatment, entirely different in some respects from almost any other group.

Some of my American friends are doubtful about the wisdom of giving identical benefits for sickness, workmen's compensation and unemployment, but it is a simplification, and it possibly removes from the insured an option which might become objectionable.

I may revert for a moment to workmen's compensation. In America the benefits are obtained through insurance with companies, and I may mention that a proportion of the business is done with companies associated with, or formed by, British insurance companies. In the United Kingdom at present, the compensation is also largely through companies or mutual trade organizations, and the former, dealing with much smaller units, look more expensive than the latter. The proposal to scrap this arrangement and the approved societies is, in my view, a mistake. I believe the persons receiving benefits and the country will lose by the change and become increasingly dissatisfied with it. Strange to discard an administration that has been successful for one that may be as successful! Has not Government departmental administration, in spite of the concluding remarks in Sir William's paper, become boring to the public, including the wage-earners; though admittedly their trade union representatives still hanker after it, perhaps because of their idealistic political views!

The American system differs from the Beveridge proposals in other ways. I mention one: the £20 funeral benefit—associated in the Report with the proposal to form an industrial assurance board which would, to an extent, take over industrial assurance. I have often expressed my dislike for insurances on the life of another merely for funerals, but they are wanted by the public because of the traditional hatred of a parish burial and because a funeral is an excuse for a family reunion with, at least, "seedy cake and sandwiches." My dislike is that expensive funerals seem to me all wrong. Giving £20 from national insurance will not prevent them, but will encourage money going to the undertakers. Might it not be better for the State to bury—or cremate—everyone? "Everyone" would take the sting from the "parish" burial, and a free choice of parson would make it personal.

As to the proposed industrial assurance board, I may add that, with a recollection, on the one hand, of the miserable failure of Post Office insurance and, on the other, of the continual improvement of industrial assurance in the service it renders and the manner of rendering it, I do not see that advantage is likely to accrue from this proposal which, my recollection hopefully tells me, is one of the bracketed items in the Beveridge Report. Alas! Sir William Beveridge would now like to remove the brackets.

After this war we shall be relatively a poor nation.\* All sorts of schemes

\* We shall be poor because we have spent over four years production in war, because we have had destruction of goods, buildings, ships, etc., and because we have sold overseas investments. We shall become permanently better off and so able to meet an increased expense of social services only if, as a nation, we work better than ever before, if we reduce sickness and industrial accidents, if we avoid all but frictional unemployment, if we live economically, and if we avoid industrial disputes. We should

involving expenditure will be pressed by one set of reformers or another; that adds to my scepticism about the scale of benefits recommended. And remember that it is a growing charge. The benefits seem sufficiently high to "tempt more people into the benefit receiving class" unless there is a continuance of the spiral of ascending wages. Without that, there lies the danger named by my American friend and also a few days ago to me by a labourer on the roads in my district, who feared that with the Beveridge Plan we should degenerate into a nation of spongers.\* May I put it another way? Could we sell, voluntarily, to the employed the benefits for the contribution the employed will pay? I doubt it—we could more easily sell three-quarters of them at a lower cost. To which Beveridge may say that, if I am right, the individual workman does not know what is good for him. But perhaps he does!

On my American friend's second point—the general community attitude on personal responsibility—I will merely say that a pennyworth of personal voluntary saving brings more feeling of security, and a pennyworth of personal kindness more happiness than three-pennyworth of State-controlled aid.

I sometimes wonder if the advantages of National Health Insurance could have been better obtained by a quite different method—one that I have seen increasingly in operation in the business with which I have been connected—a method moreover which will be handicapped by one of the Beveridge proposals to which I have objected. Some historian a hundred years hence taking a like view might suggest that the National Health Insurance method is one of the many evils that originated in Germany! But it is too late to go back—only historians do that.

One thing more. I read and heard the paper with great interest. We are all grateful for it. We only regret it did not come to us during Sir William Beveridge's Presidency of the Society. I second the vote of thanks with the greatest pleasure.

MISS FRIEDA MILLER (formerly Commissioner of Labour for the State of New York) said that it had been a great pleasure to follow Sir William Beveridge's very interesting and clear description of the development in social security as between the field of his work in this country and the field of his explorations in the United States. She found herself in great measure of agreement with him not only in his analysis, but in his prognostication as to what were the likely fields of expansion and development as far as the United States was concerned. She would add that while listening to the first two speakers she had a very lively sense of the same sort of interests at work in shaping that development where Great Britain was concerned as she had had in listening to the discussions at home.

Miss Miller wished to stress two points. She wondered whether Sir William would agree that difference between the situation in the United States and Great Britain should be emphasized. It was very difficult for anyone who had not worked in the field of Government in the United States to understand the complications that develop because of the individual State's independent right of action. The most realistic comparison was the problem of the International Labour Organization when it attempted to correlate the standards of nations which had 8-hour days, 10-hour days, 60-hour weeks, 54-hour weeks and 48-hour weeks, and when each of these presented its own problems of adjusting the interests of its nationals to the proposed change. In just that way there were very real responsibilities, not alone on those directly conducting State Govern-

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not say "we shall be well off and so can take the expense of all sorts of changes in our stride; we should say "we shall have a hard task; it is only by work and virtue that we can either afford or deserve such changes."

\* If benefits are high compared with earnings there is an increased temptation to take those benefits. The person who takes such a benefit unless it is essential to take it, in my sense of the term, a "sponger." The temptation must depend on the proportion that "benefit" bears to earnings. This argument is independent of whether there is an objectionable means test.

ments, but on the representatives in the Congress of States which had high standards in operation as against those which had low standards.

One other point of interpretation she would like to check with Sir William was on the third of the comparisons which Senator Wagner had made between the Beveridge Plan and his Bill. The comparison of facts was, of course, accurate, but she would like to comment on the following case. It was a fact that what Senator Wagner had produced was a draft Bill for a Statute. She did not believe that that draft necessarily represented his idea of what they should develop by way of social security in the United States, any more than the draft legislation which might appear in the House of Commons shortly would represent the whole objective of the Beveridge Plan. She thought that probably Senator Wagner was actively concerned at present with measures of full employment although these might be dealt with separately from the Bill which was now under discussion.

MR. F. K. HOEHLER (Director of American Public Welfare Association) thanked Sir William Beveridge for his excellent presentation of the Technical Committee's Report. The Committee, of which he was a member, spent a lot of time deliberately devising the analysis of need because they wanted in the Report to present some plans for prevention of dependency in the United States. They did recommend specific financial aid in the Youth Programme to young people who wished to extend their education, providing they could absorb it. Special work and training programmes, vocational guidance programmes, were recommended so as to make the scheme for prevention stand on a strong and stout floor in building up educational and work projects. They hoped to accomplish some measure of full employment by encouraging so far as possible the employment of men and women in normal industry and professions, and urging a big work programme to take care of those who could not find work in industry. They also recommended an extension of the aid-to-children programme. One of the great difficulties had been referred to over and over again—diversity of conditions, the great differentials in grants, both in unemployment compensation and in direct assistance—and the Committee recommended that that should be met by a Federal unemployment compensation system rather than the fifty-one systems in existence. Variable grants to States were also recommended, so as to enable them to establish some uniform standard of assistance.

With regard to the fear of creating a nation of spongers, this was expressed during the relief days in the United States; it was also said of the W.P.A.; but the authorities were now aware of the fact that because these things were done for people they were able to call upon the men and women of the United States during the present emergency more readily than if they had been neglected during those years. Some day he hoped the United States would be able to provide facts and statistics to prove this; to-day it was just a statement.

He joined in an urgent plea for some joint discussion and planning in their social programmes for the people of the two great democracies. They had fought together to bring about freedom, and as they joined together in the war and in the post-war reconstruction programmes, he hoped they would continue together in the planning of the security of the people of their respective nations.

MR. GAMPELL wished to make a small practical point. As an instance of persistent depression, Sir William had cited South Dakota and various other States marked in black on the map in the Technical Committee's Report. Most of these States were a block in the western Great Plains, and the period covered was from July 1934 to June 1935, which was a period of unprecedented drought, and accordingly not representative. The western Great Plains were characterized by extreme cyclical fluctuation rather than persistent depression.\*

\* The only map on which I recollect having seen South Dakota marked permanently black was one which showed it as the only State in the Union which Mrs. Roosevelt had not visited. It is not necessary to add that Mrs. Roosevelt immediately repaired the omission.

For the rest he would like to say how proud the Society was of Sir William Beveridge. It was easy to forget just how much water had flowed under the bridges since that December day in 1942, only a few weeks after El Alamein, when the world woke up to realize how very large an egg Sir William had laid. Men in the Middle East and elsewhere were waiting for a word, wondering whether this war was only another military exercise or whether there was to be something in it for the common man. It was in Britain's highest tradition that that word came first and most clearly from this country, from the author of the Report by Sir William Beveridge on Social Insurance and Allied Services.

Last time the speaker addressed the Society they were discussing the Keynes Currency Plan, which was said in the United States to be framed in some British selfish interest. Even Sir William's plan had been taken in a not dissimilar sense by some people in the United States. One American newspaper had said that Britain could not afford such luxuries until she had paid her debt to the United States from the last war. It was thus good to see that Sir William stressed once more that bread for everybody before cake for anybody did not in real terms cost anything. Sir William had put the Society further in his debt by crediting it with enough intelligence not to need a demonstration that bread for everybody before cake for anybody would not turn the British people into spongers.

There was great delicacy in some parts of the paper; for instance, the remark that the Latin American republics regard themselves as very much interested in social security. Mr. Gampell could testify that not only the countries of Latin America and the Middle East but all other parts of the world were keenly interested in the Plan. *Pace* Mr. A. P. Herbert, they were in no doubt whatever as to whose plan it was. To some of them the word *beveridge*—a common noun derived from a most uncommon man—had become a talisman, something like a cross between Diana of the Ephesians and the gold standard. They were not quite sure what it was, but they knew it was a good thing, and they were for it.

The vote of thanks was put to the meeting by the Chairman and carried unanimously.

The following comments were received in writing.

MR. D. CARADOG JONES: Sir William Beveridge has given students unacquainted with conditions in America an admirably lucid and valuable account in brief compass of the difference between his own proposals for social security and those favoured by authoritative spokesmen in the United States. His paper, being in the main purely descriptive, provides little scope for the critical commentary expected in a Statistical Society discussion. Perhaps the most effective line of attack would be against the title taken for the Beveridge Plan. Security may be a fitting epitaph for the elderly; it is hardly the winged word we should have expected from one with so buoyant and vigorous a spirit as its author, even if only its author by adoption. There is, I feel, a danger lest some people may be mistakenly led thereby to think of security as our first aim, whereas it is only by an increased and regulated production that we can hope to raise the standard of living for everybody. To over-stress security is like trying to rid the world of war by advocating the negative policy of disarmament, instead of urging all nations to start immediately to work together along positive and constructive lines for their common good.

In the same connection, I was struck by the single reference the paper contains to Russia. It occurs in the paragraph on p. 313 comparing various schemes of insurance against unemployment in other countries, and reads thus:—

“The Soviet Union at one time included unemployment benefit in its security scheme, but this was dropped in 1930 on the ground that there is no unemployment.”

That is a highly significant sentence. It brought to my mind certain figures relating to the age distribution of the Russian population at the 1939 Census quoted by Dr. Turin in Part II of the Statistical Journal, 1941. The number of persons of age 0 to 15 was recorded as 36·2 per cent. of the total population, and the number of age 0 to 30 was 63·1 per cent.; the corresponding percentages for Great Britain in 1937 were 22·1 and 46·7. The Russians today are a young and virile people: we in comparison are an ageing race. Is that, I wonder, the secret of their daring and adventurous pre-war plans for reconstruction, in contrast with our cautious and almost post-war pre-occupation with security?

What are the facts? No one who has given serious thought to the subject doubts that our capacity for production was growing steadily before the outbreak of war, and the war itself has vastly accelerated the rate of growth. We have Sir John Orr's authority for stating that, even under war conditions, with so considerable a proportion of men and women engaged in the services and in making munitions, our food production has increased from about 34 per cent. to nearly 60 per cent. of the total national consumption. In *The Times*' notice of a Company Meeting last March, the Chairman—it was a firm making impregnable boots—was reported as saying that when they come to make full use of their manufacturing capacity and labour force after the war, their output will be not less than 60,000 pairs of boots per week. These are but two illustrations; similar examples could be cited over a very wide field of production. Also, much of the machinery now turning out munitions can be readily adapted to the manufacture of peace-time needs.

The conclusion to be drawn from these facts is that if—and this “if” is to be stressed—we let all our machines run at full pressure, we shall be very soon faced with a problem of surpluses which the available markets cannot possibly absorb. Clearly, this flow must be regulated lest it become a flood. We must have a scientific survey of needs on the one hand and of potential resources on the other, so that a fair balance can be struck between the two. If, by international collaboration, this can be done for the world as a whole, so much the better. If not, then our own Government should take the matter in hand, following the example set by Russia. I do not suggest that we should adopt the Russian system of economy. That, in my view, is not essential. I have always believed it possible, with our present economic system, given adequate control of finance and the essential industries, to solve the problem of mass unemployment. That once solved, the fear of insecurity would no longer cast a dark shadow over the future in so many families as it does to-day.

MR. R. G. FORRESTER: Sir William brought to our attention figures that, in sum, present a grim picture of the working of our economic system in the most advanced capitalist country in the world. Even under conditions of full employment, it was estimated by the Technical Committee of the N.R.P.B., families comprising 10 million persons would still be in need of Public Aid to provide them with the minimum subsistence needs. If that is to be the picture, one can only comment that the Socialist critique is further, and strongly, reinforced.

A society must be judged by the opportunities it provides for the individuals within it. In exchange for his contribution to production for the community, each citizen has a right to expect at least a guarantee against want. In his Report Sir William Beveridge made an attempt that must surely recommend itself to this scientific Society, an attempt at a scientific evaluation of the minimum necessary to provide freedom from want. This determined, he related the proposed benefits to it, and provided for price changes. It is surely highly to be deplored that this—the crux of the whole Plan—should have been rejected by the Government. One wonders if the memorandum submitted to Sir William Jowitt by the British Employers' Confederation six days before his statement in Parliament may have had some influence. This stated “The Beveridge Report . . . would therefore mean that the minimum wage at which such a man [with wife and one child] could be expected to accept a job would have to be something a little higher than £3 a week, if he was to derive any benefit from work-

ing." This argument was also reflected in Sir William Elderton's remarks, which also conveyed echoes of Colonel Blimp. One may of course reflect that a society that cannot provide a man with wife and child with work and a wage of £3 a week stands condemned in any case.

Sir William Beveridge has expressed his belief that the fight for Social Security in Britain has been won—long ago. If by that he wishes to convey that the great majority of the people accept and desire the application of the principles of Social Security, I am in complete agreement; but can one say that the Government equally accepts and is hastening to apply them? Does Sir William really believe that when he considers the emasculation of his own Plan; when he admits (rather wistfully?) that he doesn't know when it is likely to be presented as draft legislation to the House of Commons? I do not believe he does, for he has decided to go out and fight for "at least the Beveridge Plan"—and I would congratulate him heartily on this decision.

Sir William Elderton also echoed the Jeremiahs who cry plaintively "We shall be poor"; from this one is expected to deduce that we cannot possibly afford Beveridge. According to these theorists our economy must inevitably contract. They ignore the enormous scientific and technological developments that have taken place prior to and during the war. These provide the technical prerequisites for Social Security, and if they are not utilized or deliberately suppressed or withheld the community will justly say "if this social framework does not permit of the application of scientific knowledge to the problems of satisfying human needs, then we must consider if some other framework may not be the more desirable."

MR. D. W. WALTON: This paper elucidates some of the obscurities in the Report on Social Insurance made by Sir William Beveridge—a Report which has been so widely accepted at its face value that objections to it have been generally overlooked. This is not the occasion to move Reference Back of the Plan of a distinguished ex-President; but it may be permissible to allege that it is not adequately supported by statistics. For planning a permanent economic policy there must be available to the Government a complete picture of the national economy and its prospects; and adjustment must be made between the different compatibilities and incompatibilities involved. Such existing legislation as can be regarded as concerned with Social Security has never been framed on permanent lines and has often been revised. It will be hard enough to define precisely such terms as "income" or "wage-earner." It will be extremely difficult to calculate "an income to take the place of earnings when interrupted" acceptable and satisfying to every grade of worker. It will be necessary to compute with great precision the payments to meet those exceptional expenditures connected with birth, death, and marriage on different parts of the map and for different social grades. If the figures be fixed at a minimum there will be a continual demand for revision. With regard to children's allowances, Bumble supplied the minimum amount of broth to Oliver Twist. A joint committee from the Ministry of Health, the Ministry of Food, and the Board of Education would necessarily compromise on a non-statistical foundation; while housing technicians would plump for their own definition of a family consisting of a husband, wife, and prospective child. The detailed series of statistics of unemployment by counties and towns from 1926 was interrupted after August 1939. The current series of unemployment figures on a basis of eleven areas has been modified more than once. The inclusion of Greater London with the South-eastern area makes any analysis and comparison of London figures impossible, and the classifications North-western and North-eastern make the study of changes due to the war and a comparison with pre-war experience impossible, say, for Liverpool, Manchester, Leeds or Sheffield. The Birmingham figures are concealed under one of the Midland divisions. Full figures must be available before those concerned with the critical study of proposed legislation can arrive at sound judgments. So far as Social Security involves the provision of an income (and associated treatment) designed "to bring the interruption of



earning to an end as soon as possible," it should be noted that the Ministry of Labour in December 1942 took off the register 21.5 per cent. of the total unemployed, these being persons judged to be unemployable. This figure, by the way, is an available measure of the human wreckage produced by industrial disorganization, to counteract which the Beveridge Plan is designed.

The significance of Sir William's transatlantic comparisons emphasized the need for making cognate comparisons in the United Kingdom. Social Security will mean different things to, say, the Calvinists of Scotland and the fatalists of Somerset. The most valuable part of Sir William's comparisons are those which tend to show how America is solving problems which are like our own and, indeed, like those of the rest of the world. The term Social Security as used in the Atlantic Charter is something depending on the fullest collaboration between all nations, and implies the study of similarities of conditions all over the world.

SIR WILLIAM BEVERIDGE, in reply, said: Thank you very much for your very kind reception of my paper and for the vote of thanks which you have given me. I should also like to thank all those who have contributed to the discussion, because they gave me such pleasure. May I comment briefly upon some of the more important points which have been made?

I am very glad that Sir Gwilym Gibbon mentioned the diversity of administration. That is a point which should be mentioned as distinguishing the United States from this country. On the question of name, it is arguable that instead of saying "social security" I should have said "social insurance" and used my definition of the term. When I gave my definition in Montreal one of the South American delegates said he liked it very much as distinguishing between measures of general application and measures of securing each individual against the risks that would remain, but he called that social insurance; social security for him included factory and minimum wage legislation. I gave my reasons in the paper why, on the whole, I prefer the term "social security" for my definition because there is something else for which I want to use "social insurance"—I will add, however, that I do not regard my choice as final. I believe the distinction between measures of general application and measures for helping the individual is important. Measures for helping the individual need be not merely preservative but recuperative.

SIR GWILYM GIBBON: I included that in "preservative."

SIR WILLIAM BEVERIDGE: I understand. The other point on which I agree with Sir Gwilym Gibbon is that the whole of this Report and everything in it is of less importance than has been assumed. It is, after all, only income security plus medical treatment, which is less important than the measures necessary for maintaining employment and providing decent houses and proper nutrition to everybody in this country.

All these measures of general application are very important, and most important of all is the prevention of mass unemployment. Having been asked by the Government to make a report on social insurance I could not very well tell them how to prevent unemployment, although I did my best to bring it in by making it an assumption. I hope what I have said to-day has emphasized my view of the importance of this assumption. But one must not regard it as a reason for postponing social security until mass unemployment has been dealt with. Both social security and prevention of mass unemployment are necessary; the more quickly we get on with the former the sooner we shall have our minds free for the latter.

I hope Sir William Elderton will excuse me from discussing the merits of the Beveridge proposals—that was not the subject of my paper. I must say that I still uphold everything in my Report about industrial insurance companies and the approved societies. With regard to his comment on para. 378 (where I suggest that the special schemes for the insurance and banking industries might

continue as a voluntary addition to the state scheme) I am not at one with him in regarding that suggestion as valueless. I do not make it with my tongue in my cheek; I regard it as valuable and I should like to see it done.

As regards the special schemes, I received an impressive amount of evidence showing that the feeling of the people of this country was against allowing anybody to stand in for social insurance and also to stand out of it, to get the benefit of his personal lower rate of sickness or unemployment; that is contrary to social insurance as it is understood by the people of this country and desired by them. I had such strong evidence of that that I felt it necessary to recommend the abolition of the special schemes, but I do not underrate the value of what the special schemes have done.

I am not going to discuss the question of personal responsibility except to repeat that whether or not a scheme of social security turns the people into a nation of spongers depends on whether or not it has a means test attached to it. It depends essentially on that. National health insurance has led to more membership of the friendly societies than ever before, and the introduction of compulsory insurance does not cause people not to think for themselves. This has been proved in this country by the facts.

The only other point upon which I wish to quarrel with Sir William Elderton is his assertion that this will be a poor country after this war. We were not a poor country after the last world war. If he is thinking of the loss of income from foreign investments he should remember that it was only a very small percentage of the total national income. We shall have had the enormous stimulation of invention which comes from war. I differ profoundly from any defeatist suggestion about the British people.

SIR WILLIAM ELDERTON: It is not defeatist.

SIR WILLIAM BEVERIDGE: We shall be the same people with practically the same resources and with more inventions; why should we look forward to being poorer? There is, however, one point on which I do agree with Sir William Elderton. I am not sure that the variation of needs in different parts of Britain is negligible; in fact I point out in my Report that it might be desirable to have a higher rate of contribution and benefits in London and lower rates in the rural districts. Variation of needs is not negligible; on the other hand, quite apart from the administrative convenience, there is a strong argument of general policy for having, if possible, a uniformity of benefits and contributions as signalizing the unity of the nation. The appeal of my proposals to the people of this country has been largely because they were comprehensive, because they made no differences, because they aimed at classless social justice. Every differentiation made weakens that, and in spite of the occasional misfits under a uniform scale of benefits and contributions, it is worth while to have uniformity.

I was very glad Miss Miller emphasized the difficulties in the United States of getting any national plan carried through in the face of the existence of State legislatures. The achievement of the Social Security Act in these circumstances is marvellous. Great Britain is very proud of what was done in 1906 to 1914 with a Liberal-Radical Government, but what the Roosevelt administration did in the United States under those great difficulties is even more remarkable. I also would accept what she says with regard to Senator Wagner, whose Bill is not necessarily all that he desires. I think it is still true that while I believe we can say in this country we desire freedom from want—and mean what we say by providing benefits adequate in amount as well as in time—even the most progressive people in the United States do not yet dare to say or mean as much.

I agree very much with what Mr. Hoehler said about the United States not being a nation of spongers, but they may become that if they do not get social security without a means test. The only escape from that seems to be a guaranteed minimum income by social insurance for everybody without a means test. The way to make a nation of spongers is to return to systems of poor relief. I do agree with Mr. Hoehler that I hope such joint discussion, particularly

between the British Commonwealth and the United States, on the subject of security in the widest sense will proceed. It is up to both of us to show that we can provide security for our people under free conditions better than was given in totalitarian Germany under unfree conditions. We can only do so by devoting a great deal of thought and study to the problem.

I should like to thank Mr. Gampell for all the kind things he has said. His point with regard to the map showing the distribution of distress in the period of 1934-1935 is quite correct. Since the map covers only one year it is not itself evidence of persistent poverty. But the letter-press of the Technical Committee's Report shows that in many of the black spots of the map poverty in fact persisted in other years.

As a result of the ballot taken during the Meeting the candidates named below were elected Fellows of the Society:—

John Rutherford Bellerby.  
Gerda Johanna Blau.  
Francis Bernard Bourdillon.  
Oliver Louis Brend.  
James Edward Bryce.  
Alexis Crichton, Captain.  
James Daly.  
Allan George Bernard Fisher.  
Cyril Henry George, Major.  
John Mostyn Harries.  
Gustav Herdan.  
Charles Joseph Walter Hill.  
Thomas Lewis Horabin, M.P.  
W. H. Horton.  
Alfred Iiersic.

James Sykes Jackson.  
Kathleen Lathbury, Mrs.  
William Margulies.  
Edward John Moore.  
Howard Walter Morris.  
Claus A. Moser.  
W. T. Osborn.  
Max Henry Schwab.  
Rodney Silverman.  
Thomas Harold Smith.  
Efraim Steinbock.  
Frederich Albert Tatford.  
Arthur Wood Taylor.  
Richard Ernest Yeabsley, C.B.E.

*Corporate Representatives.*

J. L. Gibson, *representing the National Council of Building Material Producers.*  
Margot Heinemann, *representing the Labour Research Department.*  
David Kemp, *representing the British Engineers' Association.*

## MISCELLANEA

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## THE ALGEBRAIC ANALYSIS OF CONTINGENCY TABLES

By S. VAJDA

THE following sections contain a description of some aspects of  $\chi^2$  tests, and analysis of variance applicable to certain types of contingency tables with multiple classifications. It is our aim to give a comprehensive survey of the measures of significance regarding main effects, interactions and aggregates of them.

Briefly stated, our procedure will be as follows: We assume that the statistical material can be classified with regard to  $n$  independent attributes. Then each subgroup will be represented by  $n$  co-ordinates  $i_1 \dots i_n$  and  $i_k$  assumes the values from 1 to  $a_k$ . For each subgroup the number of elements  $E_{i_1 \dots i_n}$ , say, and the number of those elements which possess a certain quality,  $\Theta_{i_1 \dots i_n}$ , say, is supposed to be known. The ratio  $\Theta_{i_1 \dots i_n}/E_{i_1 \dots i_n}$  will be denoted by  $Q_{i_1 \dots i_n}$ .

We then introduce new values  $x_{a_1 \dots a_n}$  by a linear transformation of the  $Q$ 's, where  $a_k$  assumes all integral values from 0 to  $a_k - 1$ . It is possible to choose this transformation in such a way that the inverse transformation is easily obtained, and that it can be recognized by inspection of the  $x$ 's whether any effects or interactions vanish. Any such disappearance would simply be indicated by certain sets of  $x$ 's being equal to zero.

When the  $x$ 's corresponding to the effects to be tested are not zero, then the significance of this fact must be examined. To this end we put the  $x$ 's in question zero and solve the equations for the remaining  $x$ 's by the method of least squares. These  $x$ 's will not exactly reproduce the  $Q$ 's, and the total of the squares of deviations, each multiplied by  $E_{i_1 \dots i_n}$ , supplies the required  $\chi^2$  measure. The number of degrees of freedom involved is equal to the number of  $x$ 's which were put zero.

## II

We turn now to the deduction of our formulae. Consider the following transformation:

$$Q_{i_1 \dots i_n} = \zeta_{a_1}^{i_1 a_1} \dots \zeta_{a_n}^{i_n a_n} x_{a_1 \dots a_n} \quad * \quad \dots \quad (1)$$

\* For all values denoted by capital letters ( $Q$ ,  $E$ ,  $F$ ,  $\Theta$ ) summation in respect of any subscript will be indicated by replacing it by 0.

Whenever a term contains the same letter in two factors, once as an index and once as a subscript, summation over all values of the index will be implied.

where  $\omega_k$  stands for a primitive  $a_k$ th root of unity, i.e., such a root of the equation  $x^{a_k} = 1$ , that all its first  $a_k$  powers are different.

It follows that  $\sum_{i=0}^{a_k-1} \omega_k^{(i-j)l} = a_k$  whenever  $i-j$  is divisible by  $a_k$  and  $= 0$  in other cases.

Also:

$$\sum_{i=0}^{a_k-1} \sum_{j=0}^{a_k-1} \omega_k^{(i-j)l} f(i) = a_k f(i_0) \quad . \quad . \quad . \quad (2)$$

where  $i_0$  is that value of  $i$  which makes  $i-j$  divisible by  $a_k$ .

In consequence of (2) the set (1) will be solved by

$$x_{a_1} \dots x_{a_n} = \frac{1}{a_1 \dots a_n} \zeta_{a_1}^{-l_1 a_1} \dots \zeta_{a_n}^{-l_n a_n} Q_{l_1} \dots l_n \quad . \quad . \quad . \quad (3)$$

We find, in particular:

$$\begin{aligned} x_0 \dots x_0 &= \frac{1}{a_1 \dots a_n} Q_0 \dots x_0 \\ x_{a_1} \dots x_{a_m} \dots x_0 &= \frac{1}{a_1 \dots a_n} \zeta_{a_1}^{-l_1 a_1} \dots \zeta_{a_m}^{-l_m a_m} Q_{l_1} \dots l_m 0 \end{aligned} \quad (4)$$

When  $Q_{10} \dots x_0 = Q_{20} \dots x_0 = \dots = Q_{a_1 0} \dots x_0$ , i.e.,

$$Q_{i_1 0} \dots x_0 - \frac{1}{a_1} Q_0 \dots x_0 = 0 \quad . \quad . \quad . \quad (5)$$

for every  $i_1$  we say that the given data show no  $(i_1)$ -effect. When

$$Q_{i_1 i_2 0} \dots x_0 - \frac{1}{a_2} Q_{i_1 0} \dots x_0 - \frac{1}{a_1} Q_{0 i_2 0} \dots x_0 + \frac{1}{a_1 a_2} Q_0 \dots x_0 = 0 \quad (6)$$

for every  $i_1$  and  $i_2$  they show no  $(i_1, i_2)$ -interaction, etc.

Multiplying each equation in (5) by  $\zeta_{a_1}^{-i_1 a_1}$  and adding in respect of  $i_1$ , we obtain, in view of (4):

$$a_1 x_{a_1 0} \dots x_0 - \sum_{i_1} \zeta_{a_1}^{-i_1 a_1} x_0 \dots x_0 = 0 \quad \text{for every } \alpha_1,$$

or

$$x_{a_1 0} \dots x_0 = 0 \quad \text{for every } \alpha_1 \text{ except } \alpha_1 = 0.$$

Similarly, (6) leads to  $x_{a_1 a_2 0} \dots x_0 = 0$  for all pairs of  $\alpha_1, \alpha_2 \neq 0$ .

These definitions are to a certain extent arbitrary. It should be noted that they conform exactly with the usual test of independence in a simple  $2^m$  contingency table only when the numbers  $E$  are equal.

Thus we conclude that the non-existence of particular effects or interactions is reflected in the disappearance of certain corresponding sets of  $x$ 's. We call the sets of subscripts of these  $x$ 's the "tested" sets, the others the "retained" ones.

### III

The main types of tests can now be classified as follows:

- |   |           |   |
|---|-----------|---|
| (a) $x_{a_1} \dots x_{a_m 0} \dots x_0 = 0$<br>for all $\alpha_1, \dots, \alpha_m \neq 0$   | } means { | that there is no $(i_1 \dots i_m)$ -interaction.  |
| (b) $x_{a_1} \dots x_{a_m 0} \dots x_0 = 0$<br>for all $\alpha_{i_1+1} \dots \alpha_m \neq 0$ and<br>for any $\alpha_1 \dots \alpha_{i_1}$ except that<br>they must not all be zero |           |   |
|   | } means { | that there is no interaction connecting $(i_1 \dots i_m)$ with one or more of $(i_1) \dots (i_i)$ . |

When  $s = 1$ , then we obtain again (a).

(b<sub>1</sub>) when we drop the last restriction  
and  $x_0 \dots \alpha_{i_1+1} \dots \alpha_m 0 \dots 0$  is  
also zero } then { there will be no  $(i_1+1 \dots i_m)$ -  
effect either.

When  $s = m$ , we have

(c)  $x_{\alpha_1 \dots \alpha_m 0 \dots 0} = 0$   
for all  $\alpha_1 \dots \alpha_m$  except  
 $\alpha_1 = \dots = \alpha_m = 0$  } which means { that there is no  $(i_1)$ -,  $(i_2)$ -...  
or  $(i_m)$ -effect or any inter-  
action connecting two or  
more of them.

When  $s = m = 1$ , then we test the  $(i_1)$ -effect itself.

(d) If, on the other hand, *only*  $(i_1) \dots (i_m)$  and all their interactions exist, then all sets except  $x_{\alpha_1 \dots \alpha_m 0 \dots 0}$  are tested, i.e., = 0.

It might be well to point out that it depends on the material dealt with, whether the testing of any of these aggregates is appropriate or not. It should particularly be noticed that it might very well happen that some aggregate of two or more effects is significant, but that none of the single effects exceeds the 5% point. The opposite might also occur. Generally the results of an analysis depend on the way in which the questions are put, and answers to different questions, referring to probability statements, need not necessarily lead to analogous conclusions.

Later on we shall make use of the fact that whenever the tested sets include a certain  $\lambda_{\alpha_1 \dots \alpha_m 0 \dots 0}$ , they will also include  $x_{\alpha_1 - \alpha_1 \dots \alpha_m - \alpha_m 0 \dots 0}$ .

#### IV

When we put, in (1),  $x_{\alpha_1 \dots \alpha_n} = 0$  for the tested sets, then we get more equations than remaining  $x$ 's to be determined. We calculate them in such a way that

$$\sum_{i_1} \dots \sum_{i_n} E_{i_1 \dots i_n} (Q_{i_1 \dots i_n} - \zeta_{\alpha_1}^{i_1 \alpha_1} \dots \zeta_{\alpha_n}^{i_n \alpha_n} x_{\alpha_1 \dots \alpha_n})^2 \dots (7)$$

is a minimum. Taking derivatives, we obtain the equation:

$$\Theta_{i_1 \dots i_n} \zeta_{\alpha_1}^{i_1 \alpha_1} \dots \zeta_{\alpha_n}^{i_n \alpha_n} = E_{i_1 \dots i_n} \zeta_{\alpha_1}^{i_1 \alpha_1} \dots \zeta_{\alpha_n}^{i_n \alpha_n} (x_{\alpha_1 \dots \alpha_n} + \mu_n) \dots \zeta_{\alpha_n}^{i_n \alpha_n} x_{\alpha_1 \dots \alpha_n} \quad (8)$$

When this set is solved, we substitute the solutions into (7) and call the resulting value  $\bar{\chi}^2$ . It follows from a well-known theorem that the value thus obtained equals:

$$\bar{\chi}^2 = \sum_{i_1} \dots \sum_{i_n} \frac{\Theta_{i_1 \dots i_n}^2}{E_{i_1 \dots i_n}} - \Theta_{i_1 \dots i_n} \zeta_{\alpha_1}^{i_1 \alpha_1} \dots \zeta_{\alpha_n}^{i_n \alpha_n} x_{\alpha_1 \dots \alpha_n} \dots (9)$$

where the  $x$ 's are the solutions of (8).

By a theorem due to R. A. Fisher (*Metron*, Vol. V) it can be proved that, provided the  $Q_{i_1 \dots i_n}$  are normally distributed with variances  $\sigma^2 E_{i_1 \dots i_n}$ , then  $\bar{\chi}^2 \sigma^{-2}$  is distributed as is Pearson's  $\chi^2$  and the number of degrees of freedom equals the number of tested sets. An estimate of  $\sigma^2$  may be provided by a weighted average of the standard deviations within all the subgroups, viz.:

$$\sigma^2 = \frac{\sum_{i_1} \dots \sum_{i_n} E_{i_1 \dots i_n} Q_{i_1 \dots i_n} (1 - Q_{i_1 \dots i_n})}{\sum_{i_1} \dots \sum_{i_n} E_{i_1 \dots i_n} - a_1 \dots a_n} = \frac{\Theta_0 \dots 0 - \sum_{i_1} \dots \sum_{i_n} \frac{\Theta_{i_1 \dots i_n}^2}{E_{i_1 \dots i_n}}}{E_0 \dots 0 - a_1 \dots a_n}.$$

This pooling of variances would, however, be unjustifiable if the probabilities corresponding to the  $Q_{i_1 \dots i_n}$ —and consequently the variances—were varying widely. To deal with this difficulty, a transformation to  $\sin^{-1} \sqrt{Q_{i_1 \dots i_n}}$  has been suggested. (Cf. M. S. Bartlett, "The Square Root Transformation in Analysis of Variance," *I.A.R. Supp.*, iii, 1936, 68.) In any case the numbers in the subgroups must be reasonably large before this "large-sample" theory can be applied.

If the above estimate of  $\sigma^2$  did not seem to be satisfactory, then the main effects and lower-order interactions might still in suitable cases be tested by comparison with the values of  $\chi^2$  obtained for the higher-order interactions. This procedure will be preferred if the data are generally heterogeneous, in order to counteract the thus created inflation of all components of the total  $\chi^2$ .

Let us further assume that by a preliminary test or otherwise we have come to the conclusion that certain effects are not significant. Then it follows from Prof. Fisher's theory of estimation that the "efficient" measure of any further effect or aggregate of effects will be given by  $\bar{\chi}_1^2 - \bar{\chi}_2^2$ , where  $\bar{\chi}_1^2$  refers to the combined aggregates of the effects known to be not significant and of those now to be tested and  $\bar{\chi}_2^2$  refers to the not significant effects only. It will be noticed that, according to the choice of  $\bar{\chi}_2^2$ , *i.e.*, according to the aggregate already known to be not significant, we shall get different "efficient" measures.

## V

When the  $E_{i_1 \dots i_n}$  are all equal (the "orthogonal" case), then (8) becomes:

$$Q_{i_1 \dots i_n} \zeta_{a_1}^{i_1 \mu_1} \dots \zeta_{a_n}^{i_n \mu_n} = \sum_{i_1} \dots \sum_{i_n} \zeta_{a_1}^{i_1 (\alpha_1 + \mu_1)} \dots \zeta_{a_n}^{i_n (\alpha_n + \mu_n)} x_{a_1 \dots a_n}$$

Now, in view of the remark at the end of III, we can replace  $\mu_k$  by  $-\mu_k$  and obtain as a solution:

$$x_{a_1 \dots a_n} = (a_1 \dots a_n)^{-1} \zeta_{a_1}^{-i_1 \alpha_1} \dots \zeta_{a_n}^{-i_n \alpha_n} Q_{i_1 \dots i_n}$$

as in (3). Hence, whereas in the general case the value of each  $x$  depends on which other  $x$ 's are being simultaneously tested, in the orthogonal case this is not so. Here every retained  $x$  has always the value given by (3). The tested  $x$ 's are, of course = 0.

This leads also to a simplification of (9):

If all  $x$ 's are retained, then  $\bar{\chi}^2$  must obviously be zero. Therefore now

$$\bar{\chi}^2 = \Theta_{i_1 \dots i_n} \zeta_{a_1}^{i_1 \beta_1} \dots \zeta_{a_n}^{i_n \beta_n} x_{\beta_1 \dots \beta_n} \dots \dots \dots (10)$$

where the  $\beta_1 \dots \beta_n$  are the tested sets. Hence  $\bar{\chi}^2$  is the total of the  $\bar{\chi}^2$  relating to each single effect separately. It is therefore convenient in the orthogonal case to test each effect separately and to use this additive property for aggregates. ( $x_{\beta_1 \dots \beta_n}$  must be calculated from (3) and substituted in (10)).

## VI

Denoting  $\zeta_{a_1}^{i_1 \alpha_1} \dots \zeta_{a_n}^{i_n \alpha_n} x_{a_1 \dots a_n}$  by  $Y_{i_1 \dots i_n}$ , we find from (2)

$$\zeta_{a_1}^{-i_1 \lambda_1} \dots \zeta_{a_n}^{-i_n \lambda_n} Y_{i_1 \dots i_n} = 0 \quad (\lambda \text{ tested sets}) \dots \dots (11)$$

and (8) can be written

$$E_{i_1 \dots i_n} \zeta_{a_1}^{i_1 \mu_1} \dots \zeta_{a_n}^{i_n \mu_n} Y_{i_1 \dots i_n} = \Theta_{i_1 \dots i_n} \zeta_{a_1}^{i_1 \mu_1} \dots \zeta_{a_n}^{i_n \mu_n} \quad (\mu \text{ retained sets}) \quad (12)$$

(11) and (12) are equivalent to (8), because  $\zeta_{a_1}^{i_1 a_1} \dots \zeta_{a_n}^{i_n a_n}$  are solutions of (11) and therefore  $\zeta_{a_1}^{i_1 a_1} \dots \zeta_{a_n}^{i_n a_n} x_{a_1} \dots x_{a_n}$  must also be solutions. The  $x_{a_1} \dots x_{a_n}$  are indefinite coefficients and must satisfy (12), which leads to (8).

Now (9) can be written:

$$\bar{\chi}^2 = \sum_{i_1} \dots \sum_{i_n} \frac{\Theta_{i_1 \dots i_n}^2}{E_{i_1 \dots i_n}} - \sum_{i_1} \dots \sum_{i_n} \Theta_{i_1 \dots i_n} Y_{i_1 \dots i_n} \quad (13)$$

When only a few sets are being tested, then (8) contains many equations and the solution becomes rather laborious. Then it will be convenient to use (11) and (12). The latter is solved by

$$Y_{i_1 \dots i_n} = \frac{\Theta_{i_1 \dots i_n}}{E_{i_1 \dots i_n}} - \zeta_{a_1}^{-i_1 \mu_1} \dots \zeta_{a_n}^{-i_n \mu_n} F_{i_1 \dots i_n} y_{\mu_1 \dots \mu_n} \quad (\mu \text{ tested sets}) \quad (14) *$$

where  $F_{i_1 \dots i_n}$  stands for  $E_{i_1 \dots i_n}^{-1}$  and the  $y_{\mu_1 \dots \mu_n}$  are again indefinite factors. They must conform to (11), hence:

$$\begin{aligned} \zeta_{a_1}^{-i_1(\mu_1 + \nu_1)} \dots \zeta_{a_n}^{-i_n(\mu_n + \nu_n)} F_{i_1 \dots i_n} y_{\mu_1 \dots \mu_n} \\ = Q_{i_1 \dots i_n} \zeta_{a_1}^{-i_1 \nu_1} \dots \zeta_{a_n}^{-i_n \nu_n} \quad (\mu, \nu \text{ tested}) \quad (15) \end{aligned}$$

After substitution of  $Y_{i_1 \dots i_n}$  from (14) into (13) we obtain:

$$\bar{\chi}^2 = Q_{i_1 \dots i_n} \zeta_{a_1}^{-i_1 \mu_1} \dots \zeta_{a_n}^{-i_n \mu_n} y_{\mu_1 \dots \mu_n} \quad (\mu \text{ tested}) \quad (16)$$

where the  $y$ 's are solutions of (15).

In the orthogonal case (see V) formula (16) leads back to (10).

## VII

The formulae (8) and (9) or (15) and (16) contain the whole solution of the problem of finding measures of significance for any aggregate of effects and/or interactions. In particular cases, however, they can be brought into a form which makes them more convenient for calculations.

We start with the case mentioned in III under (d) as the simplest. When all those and only those sets are retained in which  $x_{m+1} \dots x_n$  are zero, equation (8) becomes:

$$\Theta_{i_1 \dots i_{m0} \dots 0} \zeta_{a_1}^{i_1 \mu_1} \dots \zeta_{a_m}^{i_m \mu_m} = E_{i_1 \dots i_{m0} \dots 0} \zeta_{a_1}^{i_1(a_1 + \mu_1)} \dots \zeta_{a_m}^{i_m(a_m + \mu_m)} x_{a_1} \dots x_{a_m0} \dots 0$$

This will be solved by:

$$\zeta_{a_1}^{i_1 a_1} \dots \zeta_{a_m}^{i_m a_m} x_{a_1} \dots x_{a_m0} \dots 0 = \frac{\Theta_{i_1 \dots i_m}}{E_{i_1 \dots i_m0} \dots 0}$$

Hence:

$$\bar{\chi}^2 = \sum_{i_1} \dots \sum_{i_m} \frac{\Theta_{i_1 \dots i_m}^2}{E_{i_1 \dots i_m0} \dots 0} - \sum_{i_1} \dots \sum_{i_m} \frac{\Theta_{i_1 \dots i_m}}{E_{i_1 \dots i_m0} \dots 0} \quad (17)$$

This is the required formula for III (d), and will be used when it is desired to test whether there exists any significant effect or interaction apart from  $(i_1) \dots (i_m)$  and any of their combinations.

\* In this formula no summation over  $i_1 \dots i_n$  is to be carried out.



## VIII

Now we turn to the case mentioned in III (b). We shall, however, not deduce the most general formulae, but only those applicable when the  $s+1$ -th ...  $m$ -th attributes are twofold, and consequently  $\alpha_{s+1} \dots \alpha_m$ , which must not be 0, are necessarily 1. Then  $\zeta_{a_{s+1}} = \dots = \zeta_{a_m} = -1$  and (15) reads:

$$\zeta_{a_1}^{-i_1(a_1+\mu_1)} \dots \zeta_{a_s}^{-i_s(a_s+\mu_s)} F_{i_1 \dots i_{s-1} 0 \dots 0} y_{a_1} \dots a_{s-1} \dots 10 \dots 0 \\ = Q_{i_1 \dots i_{m0} \dots 0} \zeta_{a_1}^{-i_1 \mu_1} \dots \zeta_{a_s}^{-i_s \mu_s} \zeta_{a_{s+1}}^{-i_{s+1}} \dots \zeta_{a_m}^{-i_m} \dots \quad (18)$$

Instead of  $y_{a_1} \dots a_{s-1} \dots 10 \dots 0$  we shall write  $y_{a_1} \dots a_s$  and then the tested  $y$ 's are those for any  $(\alpha_1 \dots \alpha_s)$  except  $(0 \dots 0)$ .

It can easily be verified that the solution of (18) is

$$a_1 \dots a_s y_{a_1} \dots a_s = Q_{i_1 \dots i_{m0} \dots 0} F_{i_1 \dots i_{s0} \dots 0}^{-1} \zeta_{a_1}^{i_1 a_1} \dots \zeta_{a_s}^{i_s a_s} \zeta_{a_{s+1}}^{-i_{s+1}} \dots \zeta_{a_m}^{-i_m} \\ - F_{i_1 \dots i_{s0} \dots 0}^{-1} \zeta_{a_1}^{i_1 a_1} \dots \zeta_{a_s}^{i_s a_s} \frac{\sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_{s0} \dots 0}^{-1} Q_{i_1 \dots i_{m0} \dots 0} \zeta_{a_{s+1}}^{-i_{s+1}} \zeta_{a_m}^{-i_m}}{\sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_{s0} \dots 0}^{-1}}$$

which incidentally satisfies  $y_0 \dots 0 = 0$ .

Substituting this into (16), we obtain:

$$\bar{\chi}^2 = \frac{\sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_{s0} \dots 0}^{-1} (Q_{i_1 \dots i_{m0} \dots 0} \zeta_{a_{s+1}}^{-i_{s+1}} \dots \zeta_{a_m}^{-i_m})^2}{\left[ \frac{\sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_{s0} \dots 0}^{-1} Q_{i_1 \dots i_{m0} \dots 0} \zeta_{a_{s+1}}^{-i_{s+1}} \dots \zeta_{a_m}^{-i_m}}{\sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_{s0} \dots 0}^{-1}} \right]^2} \\ = \sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_{s0} \dots 0}^{-1} \left[ Q_{i_1 \dots i_{m0} \dots 0} \zeta_{a_{s+1}}^{-i_{s+1}} \dots \zeta_{a_m}^{-i_m} \right. \\ \left. - \frac{\sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_{s0} \dots 0}^{-1} Q_{i_1 \dots i_{m0} \dots 0} \zeta_{a_{s+1}}^{-i_{s+1}} \dots \zeta_{a_m}^{-i_m}}{\sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_{s0} \dots 0}^{-1}} \right]^2 \quad (19)$$

For III (c), i.e.,  $s = m$ , we obtain correspondingly:

$$\bar{\chi}^2 = \sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_{s0} \dots 0}^{-1} \left[ Q_{i_1 \dots i_{s0} \dots 0} \right. \\ \left. - \frac{\sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_{s0} \dots 0}^{-1} Q_{i_1 \dots i_{s0} \dots 0}}{\sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_{s0} \dots 0}^{-1}} \right]^2 \quad (20)$$

When  $s = 1$  and  $m = 2$ , then (19) gives the *measure for the  $(i_1, i_2)$ -interaction*. When  $s = m = 1$ , then (20) supplies the *measure for the  $(i_1)$ -effect*.

The formulae for  $s = 1$ , i.e., case III (a), can further be simplified, when  $(i_1)$  is also twofold, like  $(i_2) \dots (i_m)$ , but not necessarily  $(i_{m+1}) \dots (i_n)$ . (19) can then be transformed into

$$\bar{\chi}^2 = \frac{1}{F_{0 \dots 0}} [(Q_{1i_2 \dots i_{m0} \dots 0} - Q_{2i_2 \dots i_{m0} \dots 0}) \zeta_{a_2}^{-i_2} \dots \zeta_{a_m}^{-i_m}]^2 \quad (21)$$

and (20) into

$$\bar{\chi}^2 = \frac{1}{F_{0 \dots 0}} [Q_{10 \dots 0} - Q_{20 \dots 0}]^2 \quad (22)$$

The subtrahend in (19) is due to the condition  $y_0 \dots 0 = 0$ . If we omit it, as in III (b1), then we obtain:

$$\bar{\chi}^2 = \sum_{i_1} \dots \sum_{i_s} F_{i_1 \dots i_s 0 \dots 0}^{-1} [Q_{i_1 \dots i_m 0 \dots 0} \zeta_{a_1+1}^{-i_{s+1}} \dots \zeta_{a_m}^{-i_m}]^2. \quad (23)$$

for the aggregate of  $(i_{s+1} \dots i_m)$  and all its interactions with one or more of  $(i_1) \dots (i_s)$ .

## IX

One further case shall be mentioned. When it is desired to test whether any effect exists apart from two given main effects,  $(i_1)$  and  $(i_2)$ , say, the second of which is twofold, then only  $x_{a_1 0 \dots 0}$  and  $x_{0 i_2 0 \dots 0}$  remain in (8), hence:

$$\Theta_{i_1 0 \dots 0} \zeta_{a_1}^{i_1 \mu_1} = E_{i_1 i_2 0 \dots 0} \zeta_{a_1}^{i_1 \mu_1} [\zeta_{a_1}^{i_1 a_1} x_{a_1 0 \dots 0} + \zeta_{a_2}^{i_2} x_{0 i_2 0 \dots 0}] \text{ for } \mu_1 = 0 \dots a_1 - 1. \quad (24)$$

$$\Theta_{0 i_2 0 \dots 0} \zeta_{a_2}^{i_2} = E_{i_1 i_2 0 \dots 0} \zeta_{a_2}^{i_2} [\zeta_{a_1}^{i_1 a_1} x_{a_1 0 \dots 0} + \zeta_{a_2}^{i_2} x_{0 i_2 0 \dots 0}]. \quad (25)$$

The solution of (24) is:

$$\zeta_{a_1}^{i_1 a_1} x_{a_1 0 \dots 0} = E_{i_1 0 \dots 0}^{-1} [\Theta_{i_1 0 \dots 0} - E_{i_1 i_2 0 \dots 0} \zeta_{a_2}^{i_2} x_{0 i_2 0 \dots 0}]$$

and after substitution into (25) we obtain:

$$x_{0 i_2 0 \dots 0} = \sum_{i_1} \frac{E_{i_1 10 \dots 0} E_{i_1 20 \dots 0}}{E_{i_1 0 \dots 0}} \left[ \frac{\Theta_{i_1 20 \dots 0}}{E_{i_1 20 \dots 0}} - \frac{\Theta_{i_1 10 \dots 0}}{E_{i_1 10 \dots 0}} \right] \div \sum_{i_1} \frac{E_{i_1 10 \dots 0} E_{i_1 20 \dots 0}}{E_{i_1 0 \dots 0}}$$

Finally we substitute the expressions for both  $\zeta_{a_1}^{i_1 a_1} x_{a_1 0 \dots 0}$  and  $x_{0 i_2 0 \dots 0}$  into (9). We obtain:

$$\bar{\chi}^2 = \sum_{i_1} \dots \sum_{i_n} \frac{\Theta_{i_1^2 \dots i_n}^2}{E_{i_1 \dots i_n}} - \sum_{i_1} \frac{\Theta_{i_1^2 0 \dots 0}}{E_{i_1 0 \dots 0}} - \frac{\left[ \sum_{i_1} G_{i_1} \left( \frac{\Theta_{i_1 20 \dots 0}}{E_{i_1 20 \dots 0}} - \frac{\Theta_{i_1 10 \dots 0}}{E_{i_1 10 \dots 0}} \right) \right]^2}{\sum_{i_1} G_{i_1}} \quad (26)$$

where

$$G_{i_1} = \frac{E_{i_1 10 \dots 0} E_{i_1 20 \dots 0}}{E_{i_1 0 \dots 0}}.$$

When only two attributes exist, then it is obviously the same whether we test the existence of any effect apart from the two main effects or the existence of the interaction between the two. Hence then (19) and (26) coincide.

## X

When we examine extended data we can first try to find fairly large aggregates which are not significant and then fix our attention to the remaining ones. These will then efficiently be tested on the lines set out in the last paragraph of IV. The choice of the aggregates primarily to be considered will depend on the particular problem dealt with. Thus F. Yates ("The Principle of Orthogonality and Confounding in Replicated Experiments," *J. Agric. Sci.*, 1933; "The Analysis of Multiple Classifications with Unequal Numbers in Different Subgroups," *J. Amer. Stat. Assoc.*, 1934) first disposes of the combination of all interactions. But when it is not substantial which compounds are excluded at the first stages, as long as they are not significant, then the simple formulae of type (17) will become useful.

Such a procedure of elimination was found convenient in an application of our formulae to mortality rates.

The Investigation into the Mortality of Assured Lives, which is carried out by the Institute of Actuaries in England and the Faculty of Actuaries in Scotland, has led to the publication of Statistics for the Six Years 1924-29 (Cambridge, 1933). These can be subdivided in many ways and are thus most suitable for our purpose.\*

A classification was made in respect of five attributes, and an extract of the calculations shall be used as an illustration. We give two examples, the material for which is set out in Tables A and B. This restricted material is capable of triple classification, and we use the subscripts  $c$  (twofold),  $p$  (twofold) and  $y$  (sixfold) for class, profit and year respectively.  $E_0 \dots_0$  is large enough for the number of degrees of freedom of  $\sigma^2$  to be  $\infty$ .

TABLE A  
Age group 35-40  
Medically examined lives  
Duration 5 and over.

Year	LWP $c = 1, p = 1$		LNP $c = 1, p = 2$		EWP $c = 2, p = 1$		ENP $c = 2, p = 2$	
	$\Theta$	E	$\Theta$	E	$\Theta$	E	$\Theta$	E
1924	54	11,134	11	2,559.50	411	106,397.75	29	6,941.75
1925	31	10,974.50	14	2,945.75	367	108,220.25	33	9,860
1926	33	10,591.50	10	3,228.25	378	108,011.25	28	12,071
1927	34	11,061	14	3,963.75	375	110,573.25	44	14,600
1928	29	10,483.75	10	4,056.25	305	107,972	51	15,378.25
1929	39	10,074.25	20	4,237.25	383	105,807.50	39	15,641.50
Total	220	64,319	79	20,990.75	2,219	646,982	224	74,492.50

From these data we have calculated:

1,000  $Q$

Year	$c = 1, p = 1$	$c = 1, p = 2$	$c = 2, p = 1$	$c = 2, p = 2$	Totals
1924	4.8500	4.2977	3.8629	4.1777	17.1883
1925	2.8247	4.7526	3.3912	3.3469	14.3154
1926	3.1157	3.0977	3.4996	2.3196	12.0326
1927	3.0739	3.5320	3.3914	3.0137	13.0110
1928	2.7662	2.4653	2.8248	3.3164	11.3727
1929	3.8713	4.7200	3.6198	2.4934	14.7045
Totals	20.5018	22.8653	20.5897	18.6677	82.6245

Furthermore:

$$\frac{\sum \sum \sum \Theta_{c p y}^2}{E_{c p y}} = 9.47162$$

$$\frac{\sum \sum \Theta_{c 0 y}^2}{E_{c 0 y}} = 9.42115$$

$$\frac{\sum \Theta_{c 0 0}^2}{E_{c 0 0}} = 9.32025$$

$$\frac{\sum \Theta_{0 0 y}^2}{E_{0 0 y}} = 9.40460$$

$$\frac{\sum \sum \Theta_{c p 0}^2}{E_{c p 0}} = 9.33405$$

$$\frac{\sum \sum \Theta_{0 p y}^2}{E_{0 p y}} = 9.42979$$

$$\frac{\sum \Theta_{0 p 0}^2}{E_{0 p 0}} = 9.32468$$

$$\frac{\Theta_{0 0 0}^2}{E_{0 0 0}} = 9.31918$$

\* In this investigation not lives but policies were counted. Any conclusion to which our method may lead must therefore be adjusted or otherwise remain of doubtful validity. We consider, however, in what follows, the statistics merely as a basis for numerical illustration.

It follows that

$$\Theta_{000}/E_{000} = 0.0033987$$

and

$$\sigma^2 = 0.0033870$$

$L$  = Whole Life Assurance.  
 $WP$  = With participation in profits.

$E$  = Endowment Assurance.  
 $NP$  = No participation in profits.

TABLE B  
*Age group 45-50*  
*Medically examined lives*  
*Duration 5 and over*

Year	$LWP$ $c = 1, p = 1$		$LNP$ $c = 1, p = 2$		$EW P$ $c = 2, p = 1$		$ENP$ $c = 2, p = 2$	
	$\Theta$	$E$	$\Theta$	$E$	$\Theta$	$E$	$\Theta$	$E$
1924	189	26,524.50	27	4,879.75	655	110,766.75	54	9,359.25
1925	171	25,765.50	46	5,331.25	651	111,967	86	12,325.75
1926	182	24,809.75	31	5,667.75	650	112,147.75	81	14,650.25
1927	202	25,645	49	6,908	763	117,075	109	17,718
1928	158	24,501.50	37	7,158.25	698	115,736.75	93	18,762
1929	200	23,595.75	60	7,550.25	773	115,366.50	111	19,257.25
Total	1,102	150,842	250	37,495.25	4,190	683,059.75	534	92,072.50

From these data we have calculated:

$$1,000 Q$$

Year	$c = 1, p = 1$	$c = 1, p = 2$	$c = 2, p = 1$	$c = 2, p = 2$	Totals
1924	7.1255	5.5331	5.9133	5.7697	24.3416
1925	6.6368	8.6284	5.8142	6.9773	28.0567
1926	7.3358	5.4695	5.7959	5.5289	24.1301
1927	7.8768	7.0932	6.5172	6.1519	27.6391
1928	6.4486	5.1689	6.0309	4.9568	22.6052
1929	8.4761	7.9468	6.7004	5.7641	28.8874
Totals	43.8996	39.8399	36.7719	35.1487	155.6601

Furthermore:

$$\sum_{c,p} \sum_{c,p} \Theta_{c p y}^2 / E_{c p y} = 38.77147$$

$$\sum_{c,p} \Theta_{c 0 y}^2 / E_{c 0 y} = 38.66212$$

$$\sum_c \Theta_{c 0 0}^2 / E_{c 0 0} = 38.49563$$

$$\sum_y \Theta_{0 0 y}^2 / E_{0 0 y} = 38.45162$$

$$\sum_{c,p} \Theta_{c p 0}^2 / E_{c p 0} = 38.51693$$

$$\sum_{p,y} \Theta_{0 p y}^2 / E_{0 p y} = 38.53267$$

$$\sum_p \Theta_{0 p 0}^2 / E_{0 p 0} = 38.32731$$

$$\Theta_{0 0 0}^2 / E_{0 0 0} = 38.31753$$

It follows that

$$\Theta_{000}/E_{000} = 0.0063064$$

and

$$\sigma^2 = 0.0062663$$

$L$  = Whole Life Assurance.  
 $WP$  = With participation in profits.

$E$  = Endowment Assurance.  
 $NP$  = No participation in profits.

It will be found that in this instance the  $Q_1, \dots, Q_n$  are all of the same order of magnitude. Therefore the Square Root transformation mentioned in IV was dispensed with, as the two scales are equivalent to the first order of small

deviations. For the same reason any interpretation of the interactions would be the same, on whatever scale it were based.

Using formula (17) for all possible combinations of subscripts we obtain:

Test	Degr. of fr.	Age group 35-40 $\sigma^2 = 0.0033870$			Age group 45-50 $\sigma^2 = 0.0062663$		
		$\bar{\chi}^2$	$\chi^2$	(*)	$\bar{\chi}^2$	$\chi^2$	(*)
(1) Any effect? ...	23	0.15244	45.0	hs	0.45394	72.4	hs
Any effect beside—							
(2) (c)? ...	22	0.15137	44.7	hs	0.27584	44.0	hs
(3) (p)? ...	22	0.14694	43.4	hs	0.44416	70.9	hs
(4) (y)? ...	18	0.06702	19.8	n	0.31985	51.0	hs
(5) (c), (p), (cp)? ...	20	0.13757	40.6	hs	0.25454	40.6	hs
(6) (c), (y), (cy)? ...	12	0.05047	14.9	n	0.10935	17.4	n
(7) (p), (y), (py)? ...	12	0.04183	12.4	n	0.23880	38.1	hs

\* n = not significant (below the 5 per cent. limit).

s = significant (between the 5 per cent. and the 1 per cent. limit).

hs = highly significant (beyond the 1 per cent. limit).

We shall conclude that for the age group 35-40 no significant effect exists apart from the (y)-effect. This effect itself can be tested by (20), which gives:

$$(y)\text{-effect: d. fr. 5, } \bar{\chi}^2 = 0.04191, \chi^2 = 12.4; s.$$

Using, however, our knowledge that this effect is the only possibly significant one, the efficient estimate will be found from the difference of the figures under (1) and (4) above:

$$(y)\text{-effect: d. fr. 5, } \bar{\chi}^2 = 0.08542, \chi^2 = 25.2; hs \text{ (efficient).}$$

The figures for age group 45-50 show that the significant effects must be looked for among (c), (y), and (c, y). This area can further be restricted by using formula (26) for the test, whether anything beside (c) and (y) is significant:

$$\text{Apart from (c), (y): d. fr. 17, } \bar{\chi}^2 = 0.13790, \chi^2 = 22.0; n.$$

This conclusion can further be checked by a (not efficient) test of the (c, y)-interaction by (19), giving:

$$(c, y)\text{-interaction: d. fr. 5, } \bar{\chi}^2 = 0.02893, \chi^2 = 4.6; n.$$

The efficient test for (c, y) is, of course,

$$(c, y)\text{-interaction: d. fr. 5, } \bar{\chi}^2 = 0.02855 (= 0.13790 - 0.10935), \chi^2 = 4.6; n \text{ (efficient).}$$

It remains to test (c) and (y) severally. Both are hs, the efficient tests being:

$$(y)\text{-effect: d. fr. 5, } \bar{\chi}^2 = 0.13794 (= 0.27584 - 0.13790), \chi^2 = 22.0; hs \text{ (efficient).}$$

$$(c)\text{-effect: d. fr. 1, } \bar{\chi}^2 = 0.18195 (= 0.31985 - 0.13790), \chi^2 = 29.0; hs \text{ (efficient).}$$

## CONTROL CHARTS IN SCRIPT ASSESSMENT IN LARGE WRITTEN EXAMINATIONS

By FRANK SANDON, M.A.

THE usual way of assessing on a fairly objective basis educational or psychological measurements for a particular quality in a number of individuals is by the award of marks. These marks are conveniently given as numerical symbols, and the assumption is made that such symbols can be operated on by the usual rules of arithmetic. In this way we get a total mark or score for the particular individual. The marks are, however, far from possessing the objective character of a scale-reading, and it is necessary to define them as precisely as possible at each level in order that any one assessor may hold his standard steady. This definition is usually effected by a marking schedule. Such a schedule is of particular value in the case of the examination of a large number of scripts (*i.e.*, of order a thousand or more) as in the case of certain "competitive" and selective examinations in educational practice. In these there is often a panel of assistant examiners, and it is important to see that these assessors are all working on the same basis. The check on this is not easy. Repeated scrutiny by a chief examiner may disclose discrepancies, but this 100 per cent. inspection is not a practical possibility, whilst there is the psychological difficulty of the unconscious approval (in some cases; disapproval in others) of a mark already inserted on the script. The testing of the accuracy of such marks is often therefore done statistically, and it is usual when sub-examiners have batches of, say, 500 or more to compare their general levels. The scatters are sometimes compared: there is no simple way of comparing the actual relative rankings of a sub-examiner with that of the rest of the panel. Modern methods, however, make it possible to deal for the general level and the scatter with smaller batches than those just mentioned.

One of these methods is the analysis of variance. This was indicated by the writer in a review of the English International Institute of Examinations Enquiry work (*Journ. Roy. Stat. Soc.*, 1937, Vol. C, Part 1, pp. 106-110). This method has been used in practice, and has thrown considerable light on some aspects of the problem. An actual illustration will be useful. We shall limit ourselves to the case of the general level, and will not here deal with that of the scatter; the general ideas can easily be applied to this other case.

The Education Committee of one of the largest county boroughs of the country conducts every half-year a secondary schools admission examination, open to all children of age 10 in the city. About 3000 children sit each time, half of them boys, and half girls. These candidates take the written examination, each at a particular centre, one of 23, usually the school of his first choice. A school in a "good" district will therefore expect to have a better batch of candidates than a school in a "poor" district. We shall consider here simply the four papers in academic attainments, *viz.*, A 1 (chiefly mechanical drill arithmetic), A 2 (arithmetic problems), E 1 (Essay and English usage), and E 2 (comprehension of an extract, usually a description or a part of a story). The scripts of each centre for any subject are dealt with together, and are distributed to one of the three sub-examiners for that paper. They are marked

to the schedule, and then dealt with by the clerical staff to obtain the final ranking. For one particular examination, the following results were found:

TABLE I  
*Analysis of Variance for Different Papers of a Battery*

	Examination paper			
	A 1	A 2	E 1	E 2
Between candidates ... ..	11.5	17.5 <sup>1</sup>	10.2	7.4
Between two sexes ... ..	127	477	266	11
Between three examiners ... ..	62	119	294	31
Between twenty-three centres ... ..	31	54	76	15
"Error" ... ..	10.9	16.9	9.4	7.3

The working units in this table (for  $\sqrt{\text{variance}}$ ) are each ten marks. The entries cannot readily be compared horizontally for the different papers. The table should be read vertically. We can most conveniently use Snedecor's F to estimate the significance of the various figures given in the table. Table II gives these results. There is a sex difference in arithmetic, and a difference in

TABLE II  
*Significance of Different "Causes" of Table I*

Paper	Residual differences between candidates compared with differences due to			Differences due to sex compared with those due to		Differences due to examiner compared with those due to
	Sex	Examiners	Centres	Examiners	Centres	Centre
A 1 ... ..	<0.001	0.001	<0.001	>0.05	0.05	>0.05
A 2 ... ..	<<0.001	0.001	<0.001	>0.05	0.001-0.01	>0.05
E 1 ... ..	<0.001	<0.001	<<0.001	>0.05	0.05+	0.01-0.05
E 2 ... ..	>0.05	0.01	0.001	>0.05	>0.05	>0.05

A large value (say >0.05) means that the differences found may be due to a common "cause" and that there may be no other separate "cause" associated with each factor.

each subject between centres. There is also a difference between examiners, except perhaps in E 2, where we may consider that the standardization is satisfactory, though only in the case of E 1 can we be reasonably sure that this difference between examiners is not merely another form of the centre differences.

These results were obtained only by very heavy computations, and in the examination routine they are needed when time is very precious. An alternative has therefore been sought, and it is submitted that a control chart can be devised that will indicate the general results just obtained and provide as well information additional to that just given.

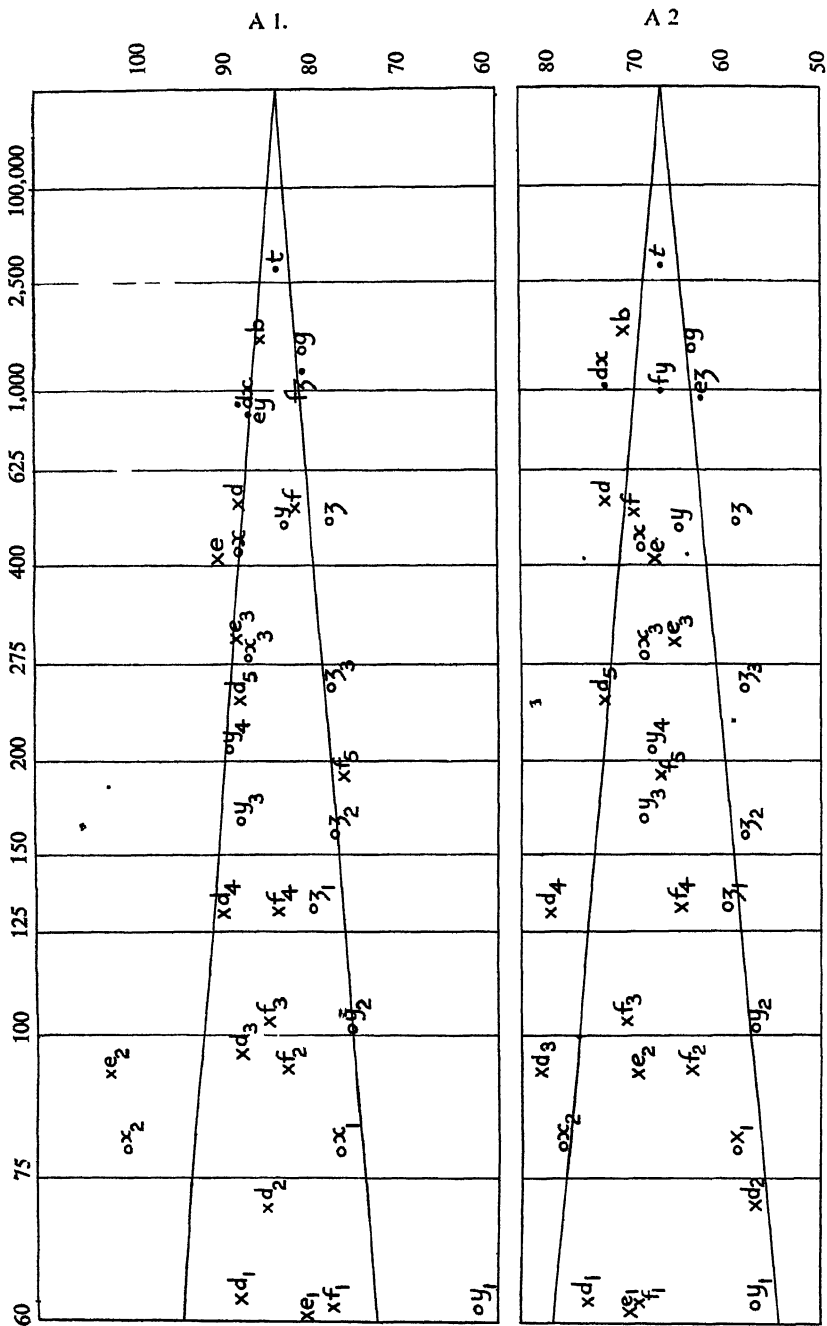
For any grouping of candidates we can obtain a frequency distribution,

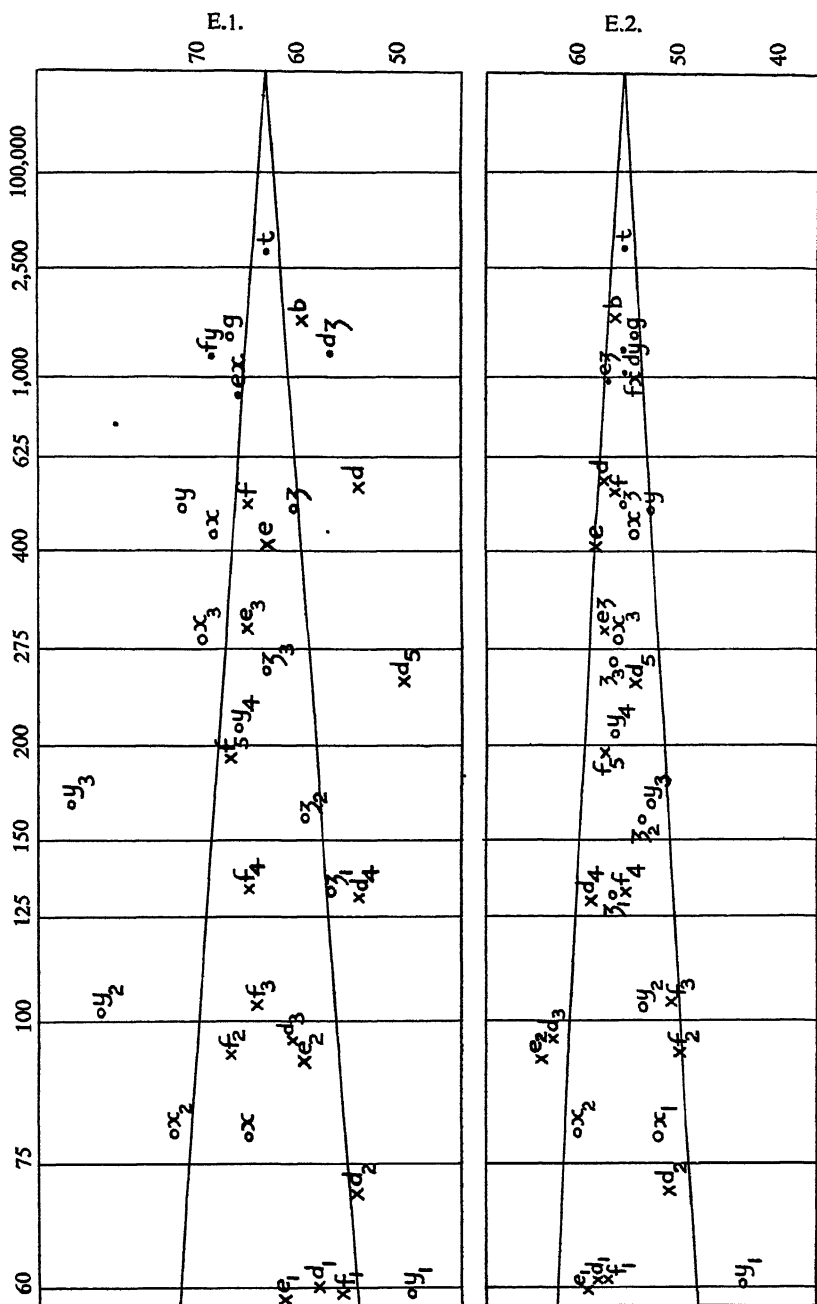
and the various statistics of the sample. It has been the practice in the examination in question to obtain the median and the upper sextile ( $S_6$ ) and the lower sextile ( $S_1$ ), to give the intersextile range,  $s$ . Then, although skew distributions were aimed at, and were obtained, especially in A 2, yet the frequency curve was still a monomodal one, with nil frequency at each end, and was, to our degree of accuracy, not too different from a normal one. So, assuming normality, we have that  $s = 1.934 \dots \sigma$ . We have also (*vide* Yule and Kendall, p. 382) that the S.D. of any sample median is  $1.2533 \dots \sigma/\sqrt{n}$ , where  $n$  is the population of the sample, and is sufficiently big to enable us to use the approximation. The numbers of our centres are of order 100, and for the other kinds of groupings up to 3000, so that for our present purposes this approximation is sufficiently close. Hence we have

$$\text{S.D.}_{\text{median}} = \frac{1.2533 \dots \sigma}{1.93 \dots \sqrt{n}} = 0.6477 \dots \frac{\sigma}{\sqrt{n}}.$$

Thus, for any particular paper, as we are dealing with samples (centres, batches marked by sub-examiners, numbers of any sex), any definite deviation from the found median varies as  $1/\sqrt{n}$  for any particular grouping. We can draw control lines to show where a deviation for a particular probability falls in any case, by using this formula, and these lines will be straight if we plot size of sample  $n$  according to the scale  $1/\sqrt{n}$ . The particular control lines needed, as always, are a matter of judgment: common ones in control chart work are 5 per cent., 1 per cent. and 0.1 per cent. As we have 23 centres, it seems convenient to work to a 1 in 23 chance in defect and a 1 in 23 chance in excess, which entail lines  $X \pm 1.71 \dots \text{S.D.}_{\text{median}}$ —i.e.,  $X \pm 1.108 \dots s/\sqrt{n}$ . Thus we obtain the four charts A 1, A 2, E 1 and E 2 of the figure where the scale for size is taken as just indicated, and the control limits are drawn at the levels mentioned. Since from Table I we note that even when we allow for the three factors—sex, examiner and centre—the variation between candidates is only very slightly reduced, we can use the same values for each statistic that we have already done for plotting these other factors. It is found convenient to mark boys  $\times$  and girls  $\circ$ , sexes combined  $\bullet$ . The whole entry, about 3000 candidates, is divided into the two sexes (about 1500 of each), and the sexes each into three groups of centres, each group being of about the same size. The boys' groups are referred to as  $d$ ,  $e$ , and  $f$ : the girls' groups as  $x$ ,  $y$ , and  $z$ . Each group consists of from three to five centres, of size from about 50 to 250. The centres are referred to as, e.g.,  $d_1$ ,  $d_2$ ,  $d_3$ , and  $d_4$ . The examiners are referred to as  $dx$ , etc., this first being the subexaminer who marks the boys' centres in group  $d$  and the girls' centres in group  $x$ . The panel of subexaminer $s$  is, of course, different for the different papers, but each subexaminer marks a group of boys' papers and a group of girls' papers, the changes being rung on the different combinations over the different papers. It is clear that there is considerable difference between the centres, and that centres  $x_2$ ,  $e_2$ , and  $d_3$  are definitely above the average and  $y_1$  below the average. From the way the candidates select their own centre, there seems no good reason why one centre should be definitely better than another in one subject only. In this the case is different from that of a particular school, where the candidates can be prepared by especially efficient coaching in one subject, and it is to be distinguished again from the difference that arises by superior ability, for these all subjects should show a lead in the more favoured case. So that the relatively defective score of  $e_2$  and  $d_3$  and the excess score of







$y_2$  and  $y_1$  in E 1 alone is probably due to some other cause than that due to the centre itself. We may note, however, that the chart gives an indication of this relative fluctuation due to candidates and to centres: the figures of Table I are all significant, that of the least pronounced, E 2, being just above the 0.1 per cent. level.

If we look at the right-hand end of the charts we note the fluctuations due to sex and to examiner. As was expected from Table I, in E 2 these fluctuations are hardly noticeable, and are not significant at the 1:23 level. In A 1 there is a significant sex difference, and a significant difference between standards of examiners (though popular belief says that it is easier to mark objectively a drill arithmetic paper than any other). Of the A 1 examiners we notice that  $dx$  and  $ey$  mark too high whilst  $fz$  marks too low. If we imagine the two control lines slide up so that the median line passes through the summary point for any one sex, we can estimate how far any examiner differs when marking this sex. We conclude that  $dx$  overmarks the girls. If we similarly slide this median line to pass through the final point for any one examiner, then we can see how far this sub-examiner differs from the others in distinguishing between the sexes: here, in A 1, the differences found with any sub-examiner seem, to our 1:23 limit, to be sampling errors. This actually tells us more than Table I, for it enables us to put our fingers on the sources of the discrepancies.

We may similarly proceed with A 2, where, as Table I shows, the sex difference is the important thing, and with E 1. In the latter, examiner  $fy$  overmarks everyone and examiner  $dz$  under-marks: the former shows his particular tendency with the girls, and the latter with the boys. In other words, the standardization in this paper is not successful: it was on evidence such as that provided by this chart that the arrangements for this part of the examination were extensively modified.

The preparation of the control lines is far more rapid than the computations for the analysis of variance, and the lines, as indicated above, can be used to give a great deal of information necessary for the proper conduct of examinations.

#### *Postscript.*

Since the above was written, further experience has indicated some useful modifications in the above procedure. It will be remembered that the error in the S.D. as determined by an interquantile range is least when the percentiles of approximately 7 and 93 are used. For centres of our size, however, the small number errors are rather great at these levels. It has been found that the interdecile range can be used more conveniently, and this has been done in place of the intersextile range of the text. It is found for each centre and other grouping in each of the four papers. As experience further indicated that the centres were not a random sample of all candidates—certain were in "better" districts—control lines at theoretical distances are neither necessary nor desirable. It has been found useful for this particular examination to draw these at median  $\pm$  (interdecile range)/ $\sqrt{n}$ .

## A NOTE ON THE TREND OF POPULATION AND THE LABOUR PROBLEMS OF THE U.S.S.R.

By ALEXANDER BAYKOV

WHILE the available data at my disposal do not allow a close analysis of population and labour problems in the U.S.S.R., it is sufficient to indicate some of the problems of its post-war labour situation.

1. In spite of the enormous losses in population which occurred during the 1914-17 war and the first years of the revolution, 1917-20, in which there was an absolute decrease of nearly 8 millions, the population of the U.S.S.R. in 1939 exceeded that of 1914 by 31.2 millions.

Population (in millions)

	Urban	Rural	Total	Percentage urban
1914 ... ..	24.7	114.6	139.3	17.7
1920 (Census) ... ..	19.4	112.2	131.6	14.7
1926 (Census) ... ..	26.3	120.7	147.0	17.9
1929 (Estimate) ... ..	27.6	126.7	154.3	17.9
1933 (Estimate) ... ..	39.7	126.0	165.7	24.0
1939 (Census) ... ..	55.9	114.6	170.5	32.8

During the period between the two censuses of 1926 and 1939—i.e., during 13 years—the population increased by nearly 23½ millions, or by 15.9 per cent. The average yearly increase was thus 1.23 per cent. This rate of annual increase was much higher than the rates for other countries in the same period (U.S.A. 0.67 per cent., Germany 0.62 per cent., Italy 0.90 per cent., Great Britain 0.36 per cent., France 0.08 per cent.), but much lower than that of pre-revolutionary Russia and of the U.S.S.R. during the years 1924-28 for which period we have detailed data concerning birth and death rates.

(Per hundred of population)

	Births	Deaths	Natural increase
European part of the U.S.S.R. 1911-1913 ...	4.55	2.86	1.69
1924 ...	4.29	2.20	2.09
1925 ...	4.42	2.29	2.13
1926 ...	4.35	1.99	2.36
1927 ...	4.27	2.10	2.17
1928 ...	4.11	1.81	2.40

Increase of Population in 1926

Cities with over 100,000 inhabitants ...	2.89	1.40	1.49
Cities with over 50,000 inhabitants ..	3.16	1.69	1.47
Cities with under 50,000 inhabitants ..	3.75	1.74	2.01
Total urban population ... ..	3.39	1.66	1.73
Rural population ... ..	4.56	2.07	2.49
Total population ... ..	4.35	1.99	2.36

The birth rate slowly declined during 1925 to 1928, but as mortality declined more rapidly the natural increase of population was higher than in 1911-13.

I consider, therefore, that the rate of increase during 1926-39—i.e., 1.23 per cent., does not reflect the normal annual increase of the population of the U.S.S.R. It is much lower even than that of the largest cities, not only in 1926, but in 1938 (births per thousand of population in 1938 in Moscow were 28.5, in Leningrad 27.4, in Kiev 27.4, in Kharkov 27.7, in Baku 33.9).

Evidently this (for the U.S.S.R.) abnormally low coefficient of annual increase of population reflects the abnormal conditions which existed during the period 1929-33: namely, the policy of "liquidation of the kulaks as a class", which affected the normal life of about 5.5 millions (in 1928, 3.7 per cent. of the total population were considered "kulaks"), the deterioration in food supplies, especially for the rural population (the harvest of grain and the number of livestock considerably declined from 1928 to 1933), and the destruction of family life owing to the great mobility of the population and the facilities for divorce and abortion.

Some indices (of marriages, divorces, abortions and birth rates for some cities, etc.) give reason to assume that the rate of increase of population was much higher than 1.23 per cent. after 1933 and especially after 1935-36 (the end of extensive collectivization, cessation of rationing and introduction of a series of decrees prohibiting abortion, hampering divorce, raising obligations as regards alimony, etc.).

Consequently it would be wiser to consider the coefficient of 1.23 per cent. not as normal for the annual increase of the population of the U.S.S.R.—not as expressing organic changes, but only the specific conditions of this period. In normal conditions the natural increase would, I think, be not less than 1.7 per cent. (that is, on the level of the natural increase of total urban population in 1926), and in calculating the future trend we must reckon with a coefficient of this order.

2. During 1926-39 there were enormous migrations to the Caucasus and the Asiatic republics and to the eastern and south-eastern provinces of the U.S.S.R.

### *Census Populations (in 000's)*

	1926			1939			1939 as percentage of 1926		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
I. R.S.F.S.R. ...	16,755	76,673	93,428	36,658	72,821	109,379	218.1	94.7	116.9
II. Ukraine S.S.R. ...	8,374	23,669	29,043	11,196	19,761	30,950	208.3	83.6	106.6
III. White Russian S.S.R. ...	847	4,135	4,983	1,373	4,195	5,568	161.9	101.5	111.7
IV. Azerbaydzh S.S.R. ...	650	1,664	2,314	1,161	2,049	3,210	178.7	123.1	138.7
V. Gruzia S.S.R. ...	594	2,083	2,677	1,067	2,476	3,543	179.5	116.9	132.3
VI. Armenian S.S.R. ...	167	714	881	366	915	1,282	219.3	128.1	145.1
VII. Turkmenian S.S.R. ...	137	861	998	416	838	1,254	304.0	97.3	123.6
VIII. Uzbekian S.S.R. ...	1,012	3,533	4,545	1,445	4,837	6,282	142.8	136.1	137.6
IX. Tadzhik S.S.R. ...	106	936	1,032	252	1,233	1,485	237.6	133.1	113.9
X. Kazakh S.S.R. ...	519	5,555	6,074	1,706	4,440	6,146	328.7	79.9	101.2
XI. Kirgiz S.S.R. ...	122	879	1,001	271	1,189	1,460	221.2	135.2	115.9
U.S.S.R. ...	26,314	120,713	147,027	55,910	114,557	170,467	212.5	94.9	116.9

In the R.S.F.S.R. the greatest increase was in the eastern provinces: Sverdlovsk province 53 per cent., Novosibirsk province 53 per cent., Irkutsk province 49 per cent., Chita province 73 per cent., Khabarovsk province 136 per cent., Primorskii province 42 per cent. Altogether, during the course of 1926-39 more than 3 million people migrated to the Urals and to the Far East.

In some of the predominantly agricultural provinces of the U.S.S.R., on the contrary, the population decreased, especially in Kalinin, Kursk, Riazan, Penza, Smolensk, Poltava, Vinnitsa, Pavlograd, Kustanaisk provinces; these provinces had had agrarian over-population and the decrease must be considered as a progressive factor.

3. During the period under review there occurred an enormous increase in urban population, which more than doubled in the course of 13 years, while the urban population in pre-revolutionary Russia had grown relatively slowly (in 1897 11.5 per cent. of the population were urban, in 1914, 17.7 per cent.).

*Rise in population during the course of 13 years*  
(In thousands)

	1897-1910	1926-1939
Moscow ... ..	442.6	2,107.6
Baku ... ..	25.7	356.0
Gorkiy ... ..	11.2	421.7
Dnepropetrovsk ... ..	99.1	263.9
Stalingrad ... ..	45.4	294.0
Sverdlovsk ... ..	26.8	285.2
Ivanovo ... ..	45.8	173.5
Arkhangelsk ... ..	13.3	204.5
Alma-ata ... ..	13.4	185.1

	1897	1914	1926	1939
Number of towns with population of over 50,000 ... ..	40	71	85	174
over 100,000 ... ..	14	21	31	82

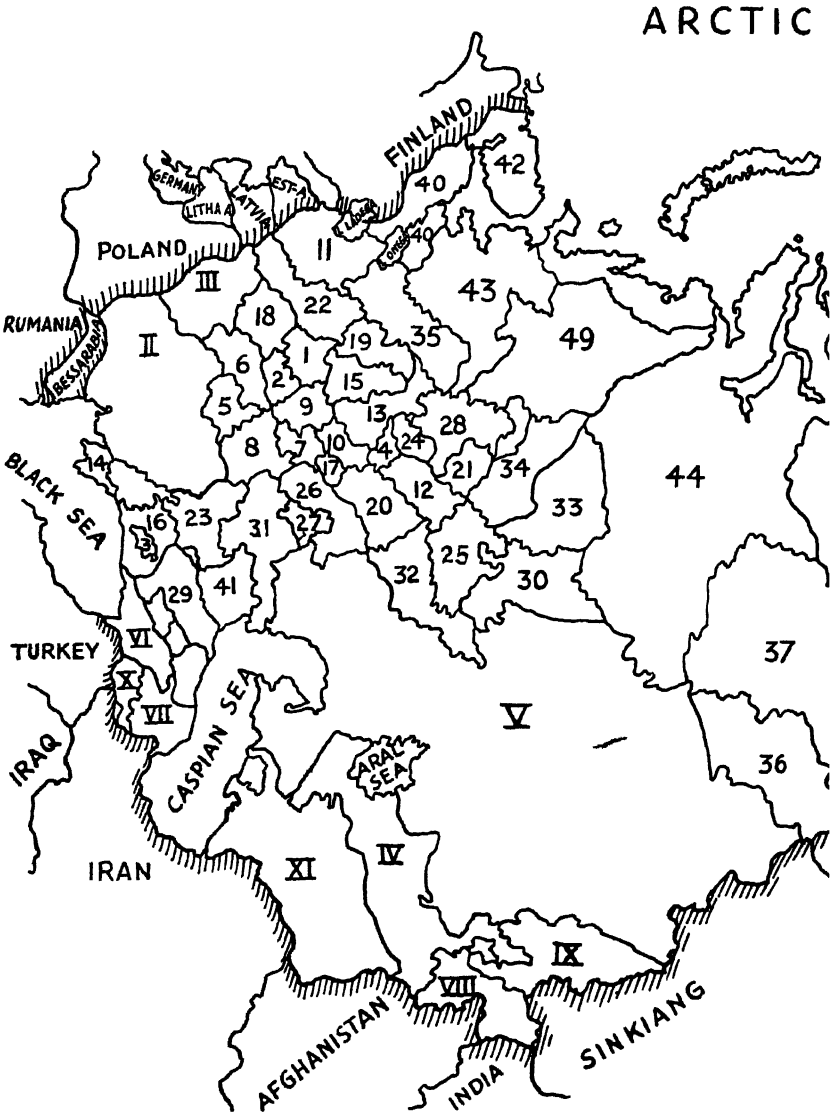
The number of towns with a population of over 50,000 was in 1939 nearly  $4\frac{1}{2}$  times as great as in 1897 and  $2\frac{1}{2}$  times compared with 1914. Even greater was the increase in the number of towns with a population of over 100,000—nearly 6 times compared with 1897 and nearly 4 times compared with 1914.

This urban increase was, of course, mostly due to the migration of the village population to the towns.

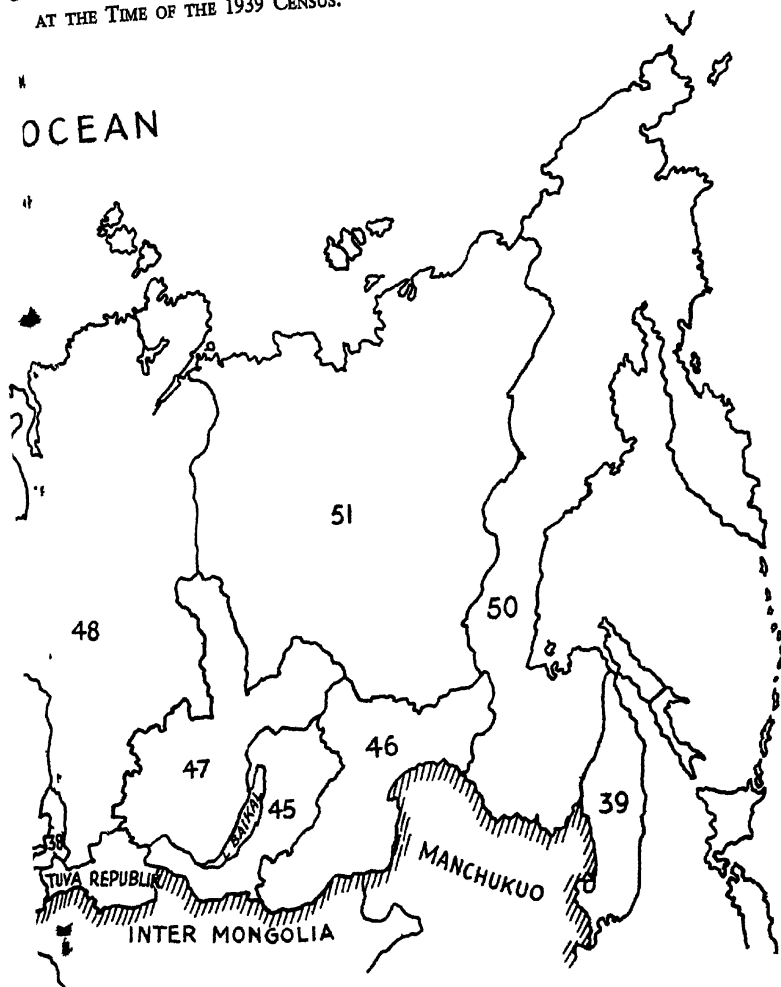
(In millions)

	Urban population	Rural population	Total
Census 1926 ... ..	26.3	120.7	147.0
Migrated from villages to towns ... ..	-18.5	-18.5	—
Natural increase ... ..	+ 5.3	+ 18.2	+ 23.5
Population of towns which had been transformed from villages into towns ... ..	+ 5.8	- 5.8	—
Census 1939 ... ..	55.9	114.6	170.5

FRONTIER AND ADMINISTRATIVE DIVISIONS



AT THE TIME OF THE 1939 CENSUS.





During 13 years 18.5 millions of rural population migrated to towns and, in addition, 5.8 millions of villagers became townsfolk.

This rise in urban population was spread over all the territories of the U.S.S.R., and especially in an eastward direction.

For every 100 rural inhabitants the urban population numbered:

	Census 1926	Census 1936	Rise in urban population (1936 as percentage of 1926)
R.S.F.S.R. ... ..	21.9	50.5	218.4
U.S.S.R. ... ..	22.7	56.6	208.3
B.S.S.R. ... ..	20.5	32.7	161.9
Azerbaidzhan S.S.R. ... ..	39.1	56.6	178.7
Georgian S.S.R. ... ..	28.5	43.1	179.5
Armenian S.S.R. ... ..	23.4	40.0	219.3
Turkmenian S.S.R. ... ..	15.9	49.7	304.0
Uzbek S.S.R. ... ..	28.5	29.9	142.8
Tadzhik S.S.R. ... ..	11.4	20.4	237.6
Kazakh S.S.R. ... ..	9.3	38.4	328.7
Kirgiz S.S.R. ... ..	13.9	22.8	221.2
Total ... ..	21.8	48.8	212.5

The lowest rate of increase in urban population was in Uzbek and White Russian S.S.R., the highest in Kazakh and Turkmenian S.S.R., but in Tadzhik, Armenian and Kirgiz S.S.R., too, the tempo of increase of urban population was higher than the average for the U.S.S.R. The urban population rose particularly in the Ural, Far Eastern and East Siberian provinces: the urban population of the Ural provinces was (in thousands) 681 in 1914, 1,258 in 1926, and 3,513 in 1939, of which 1,259 thousand live in five towns with populations of over 100,000. The urban population of Novosibirsk province rose from 189 thousand in 1914 to 385.6 thousand in 1926 and 1,655 thousand in 1939, of which 67 per cent. live in towns with populations of over 50,000. The urban population of the East Siberian and Far Eastern provinces rose (1926-39) more than three times—i.e., from 890 to 2,980 thousand—whereas the rural population rose only by 17.5 per cent.—from 4 to 4.7 millions.

4. The density of population in the U.S.S.R. continues to be very low, except in the Ukraine, the Caucasian republics and old Russian industrial and agricultural provinces. (See figures in Appendix I.)

The most densely populated republics are the Ukrainian, Georgian, Armenian and Azerbaidzhan S.S.R., but in the old Russian industrial and agricultural provinces the density of population is greater than the average for the Ukraine.

Soviet economists considered that the following regions had relative agrarian over-population and had reserves of agricultural population for migration to other regions and for the supply of seasonal workers to other regions: the north-western districts of the Ukraine, Tambov province, Voronezh, Penza, Kursk, Orel provinces, Mordov, Tatar, Chuvash A.S.S.R., Kirov and Kuibishev provinces. As can be seen from the figures in Appendix I, these provinces are purely agricultural provinces, with an urban population of less than 10 per square kilometre.

The regions considered to have the greatest need of an inflow of population were: Far East—Primorskii and Khabarovskii provinces; Eastern Siberia—

Krasnoyarskii, Irkutskii and Chitinskii provinces and Burato-Mongolian A.S.S.R.; Western Siberia—the greater part of the provinces of Omsk, Novosibirsk and Altai; Ural—Cheliabinsk and Chkalov provinces; Kazakhstan and certain districts of the middle-asiatic republics.

These regions had a very low density of rural population (see Appendix I), but a *relatively* high density of urban population—i.e., development of the latter started only with the exploitation of the mineral resources of these regions. For example, the population of the Far East is only 1.4 per cent. of the total population of the U.S.S.R. (2,338 thousand, of whom 1,112 are urban and 1,226 rural), whereas the territory accounts for 13.1 per cent. of the total territory of the U.S.S.R. and possesses very rich natural resources: prospected coal deposits in Khabarovsk province amounted to 64 milliard tons, iron ore deposits to 700 million tons; the forest resources of the Far East are equal to the total resources of Sweden, Norway and Finland, and there are very rich possibilities for the fishing industry and agricultural cultivation (in 1938, owing to lack of manpower, Kolkhozes in the Khabarovsk regions cultivated only 25 per cent. of the land belonging to them; in the Burato-Mongolian republic every Kolkhoz peasant household has an average of 65 hectares of land and every Kolkhoz an average of 6,500 hectares; an average of more than 9,000 hectares of land belong to Kolkhozes and about 120 hectares to Kolkhoz households in the Chita province, etc.).

Thus the potential possibilities for migration of population to the Eastern and Far Eastern regions of the U.S.S.R. are very considerable and, with good organization, the normal increase of the population of the U.S.S.R. can easily be absorbed by new regions which have only just started to develop their economic resources.

5. Owing to the rapid industrialization of the U.S.S.R. in the last ten years, the yearly demand for additional labour, especially skilled labour, grew steadily, and economic organizations experienced difficulties (especially in 1938–40) in procuring the necessary labour.

This is confirmed by the following facts:

(a) The number of workers and employees yearly rose steadily:

(In millions)

1926–27	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940
10.0	11.6	12.2	14.5	19.4	22.9	22.3	23.7	24.8	25.8	27.0	27.0	—	30.4

(b) The employment of women also steadily rose, especially in Industry.

*Number of women (workers and employees)*

(In millions)

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Total national economy ...	3.3	3.9	4.3	6.0	7.9	7.2	8.0	8.5	9.4
Industry ...	0.9	1.2	1.4	2.0	2.2	2.3	2.6	2.9	3.3
Building and construction ...	0.6	0.2	0.2	0.4	0.4	0.4	0.4	0.4	0.5
Transport ...	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.4	0.5
Trade ...	0.1	0.3	0.4	0.7	0.8	0.8	0.8	0.8	0.8
Social services and administration ...	0.9	1.1	1.3	1.6	1.8	1.9	2.0	2.2	2.5
Agriculture ...	0.4	0.4	0.2	0.4	0.5	0.6	0.7	0.6	0.5

In 1929 female labour in the whole national economy amounted to 27.2 per cent. of the total employed labour, in 1937 to 35.4 per cent.

(c) The fluctuation of labour, owing to the ease of finding jobs, was much greater than normal, and measures to lower the rate of fluctuation of labour were constantly introduced.

(d) In 1938-40 industrial Commissariats experienced difficulties in the recruiting of unskilled and seasonal labour, and they often competed with each other in an endeavour to procure it. Special measures (decree of July 21st, 1938, concerning recruitment of labour from Kolkhozes, decree of May 27th, 1939, concerning obligatory minimum of working days for Kolkhoz farmers, decision of the Government of August 15th, 1939, concerning the transportation of seasonal labour and of October 1st concerning the allocation of regions from which and for which labour was to be recruited, etc.) aimed at organizing recruitment of labour for industry from Kolkhozes, pressing the latter to release more labour for industry.

(e) In 1940 strong measures were taken for more intensive utilization and allocation of available skilled labour. By decrees of June 26th and October 19th the number of working hours was increased, it was forbidden to leave an undertaking or to move to another without the permission of the head of the undertaking, and the authorities received right of compulsory transfer of engineers, employees and skilled labour from one enterprise to another and from one region to other regions.

(f) To assure a steady flow of skilled labour for the satisfaction of the increased demands of industry and transport, "State Labour Reserves" were to be prepared. A series of decrees in 1940 ordered the recruitment of youths for training in specially created or reorganized industrial and transport schools. The decrees laid down that annually between 800,000 and 1 million new recruits between the ages of 14 to 17 must be recruited or conscripted from towns and villages, the training period being from 6 months to 2 years.

Thus the Soviet Government anticipated the possibility of absorbing yearly not less than 1 million of new skilled workers in industry and transport, should the normal development of the national economy continue.

6. On the eve of the war the U.S.S.R. had at its disposal about 85 millions of population between the ages of 20 and 60.

(In thousands)

Division of population						Census 1930 (Jan 17th)
Up to 7 years	...	...	...	...	...	31,412
8-11	"	...	...	...	...	16,409
12-14	"	...	...	...	...	13,336
15-19	"	...	...	...	...	15,124
20-29	"	...	...	...	...	30,639
30-39	"	...	...	...	...	25,332
40-49	"	...	...	...	...	15,235
50-59	"	...	...	...	...	10,867
60 years and over without indication of age	...	...	...	...	...	11,165
Total	...	...	...	...	...	169,519

In 1939 82 millions of the population were between the ages of 20 and 60, and I estimate an additional 3 million (at least) as the result of the transition of population from the 18-19 age group to the 20-21 group and from the 58-59 to the 60-61 age group between January 1939 and June 1941. Of these 85 million, approximately 41 million were men and 44 million women. I have, of course, no data about the numbers of population absorbed in the army.

7. The German occupation of the territories of the U.S.S.R. up to November 1941 affected areas in which there lived in 1939 approximately 30 per cent. of the total population of the U.S.S.R., or about 52 millions. The extension of occupation up to October 1942, brought the total up to 38 per cent. or about 65 million of population. (See Appendix II.) It is very difficult to guess how much of this population was evacuated.

8. Naturally all prognoses as regards post-war labour problems in the U.S.S.R. are very problematical. But in the short run the following will influence its labour position.

(a) The level of employment in the U.S.S.R. did not and will not depend on the development of foreign trade, but will be influenced by internal conditions of the development of the national economy.

(b) The enormous destruction of civil buildings and industrial plants which occurred during the war will require the employment of many millions of labourers in the building industry (in 1932-37 over 2.5 millions were normally employed in the building industry).

(c) During the war industrial production has been shifted to the War industry to a much greater degree than in any other of the belligerent countries (Germany not excepted), and consequently, in the post-war period, there will be a famine in industrial goods of every kind.

(d) During the war the shifting of industrial production, skilled workers and urban population from old industrial regions to Eastern regions will result in the settling down of a part of these industries and population in new regions.

This will result in the speedy development of the economy of these regions in which there are all the pre-requisites for further development. This development of new regions will not hamper the development of the economies of the old industrial and agricultural regions, but, on the contrary, will stimulate their development.

All these premises and experiences of the ten years preceding the war, as well as the experience in the mobilization of the economy for war, lead one to the assumption that after the war the U.S.S.R. will re-start the process of reconstruction of the national economy on a large scale and consequently there will be a shortage of skilled labour, as was experienced during the immediate pre-war years.

## APPENDIX I

	Total population	Total popu- lation per sq. kilometre	Rural popu- lation per sq. kilometre	Urban popu- lation per sq. kilometre
I. R.S.F.S.R. (comprising Nos. 1-51 below) ... ..	108,809,469	6-52	4-33	2-19
II. Ukraine S.S.R. ... ..	30,960,220	55-44	35-40	20-05
III. White Russia S.S.R. ... ..	5,567,976	24-39	18-38	6-01
IV. Uzbek S.S.R. ... ..	6,282,446	15-30	11-78	3-52
V. Kazakh S.S.R. ... ..	6,145,937	2-25	1-62	0-63
VI. Georgia S.S.R. ... ..	3,542,289	51-12	35-72	15-39
VII. Azerbaydzhan S.S.R. ... ..	3,209,727	37-54	23-96	13-58
VIII. Tadzhik S.S.R. ... ..	1,485,091	10-44	8-67	1-77
IX. Kirgiz S.S.R. ... ..	1,459,301	7-24	5-90	1-34
X. Armenian S.S.R. ... ..	1,281,599	42-86	30-61	12-25
XI. Turkmenian S.S.R. ... ..	1,253,985	2-59	1-73	0-86
R.S.F.S.R.:				
1. Moscow province ... ..	8,918,389	180-53	53-64	126-89
2. Tula province ... ..	2,049,950	64-26	41-97	22-30
3. Adygeiskaya A.S.S.R. ... ..	241,773	61-99	44-74	17-26
4. Chuvash province ... ..	1,077,614	60-20	52-85	7-35
5. Kursk province ... ..	3,196,814	58-44	53-21	5-23
6. Orlovskaya province ... ..	3,482,388	53-25	42-65	10-60
7. Tambov province ... ..	1,882,139	52-87	44-98	7-89
8. Voronezh province ... ..	3,551,009	52-61	42-86	9-74
9. Ryzan province ... ..	2,265,873	49-26	44-50	4-76
10. Mordovskaya province ... ..	1,188,598	46-61	43-38	3-23
11. Leningradskaya province ... ..	6,435,076	44-78	16-12	28-67
12. Tatarskaya A.S.S.R. ... ..	2,919,423	43-50	34-25	9-25
13. Gorkovskaya province ... ..	3,876,274	43-46	29-79	13-66
14. Krimea A.S.S.R. ... ..	1,126,824	43-34	20-81	22-53
15. Ivanovskaya province ... ..	2,650,383	41-80	23-38	18-43
16. Krasnodar province ... ..	3,172,885	39-37	29-88	9-49
17. Penza province ... ..	1,708,656	38-40	32-03	6-37
18. Smolensk province ... ..	2,690,779	37-27	31-06	6-20
19. Yaroslav province ... ..	2,271,307	36-00	23-37	12-62
20. Kuibyshev province ... ..	2,767,562	31-92	23-00	8-92
21. Udmurtskaya A.S.S.R. ... ..	1,220,007	31-36	23-12	8-24
22. Kalinin province ... ..	3,211,439	30-18	23-58	6-60
23. Rostov province ... ..	2,894,038	28-74	16-20	12-54
24. Mariyskaya province ... ..	579,466	24-81	21-61	3-20
25. Bashkirskaia A.S.S.R. ... ..	3,144,713	22-38	18-60	3-78
26. Saratov province ... ..	1,798,805	21-83	13-75	8-08
27. German Volga A.S.S.R. ... ..	605,542	21-47	16-80	4-67
28. Kirovskaya province ... ..	2,226,109	19-79	16-86	2-93
29. Ordgonikidze province ... ..	1,949,340	19-03	15-18	3-85
30. Chelyabinsk province ... ..	2,802,949	17-25	9-98	7-27
31. Stalingrad province ... ..	2,289,049	16-91	10-31	6-59
32. Chkalovsk province ... ..	1,677,013	13-55	10-48	3-07
33. Sverdlovsk province ... ..	2,512,175	13-02	5-20	7-82
34. Molotov province ... ..	2,082,166	12-47	7-54	4-53
35. Vologodskaya province ... ..	1,662,258	11-08	9-18	1-90
36. Altaisk province ... ..	2,520,084	8-64	7-25	1-39
37. Novosibirsk province ... ..	4,022,671	6-56	3-86	2-70
38. Khakasskaya A.S.S.R. ... ..	270,655	4-62	2-75	1-87
39. Primorskiy province ... ..	907,220	4-39	2-25	2-14
40. Karelskaya A.S.S.R. ... ..	469,145	3-44	2-34	1-10
41. Kalmytskaya A.S.S.R. ... ..	220,723	2-97	2-50	0-47
42. Murmanakaya province ... ..	291,188	2-10	0-33	1-77
43. Archangelsk province ... ..	1,199,178	1-84	1-17	0-67
44. Omsk province ... ..	2,366,603	1-64	1-30	0-34
45. Buryato-Mongolskaya A.S.S.R. ... ..	542,170	1-63	1-14	0-49
46. Chita province ... ..	1,159,478	1-61	0-90	0-71
47. Irkutsk province ... ..	1,286,696	1-43	0-81	0-62
48. Krasnoyarsk province ... ..	1,940,002	0-91	0-65	0-26
49. Komi A.S.S.R. ... ..	318,969	0-85	0-77	0-08
50. Khabarovsk province ... ..	1,430,875	0-56	0-30	0-25
51. Yakutsk province ... ..	400,544	0-13	0-11	0-03

## APPENDIX II

(In thousands)

	Population Total	In occupied areas up to October 1942
U.S.S.R. ... ..	170,467	65,015
European U.S.S.R. ... ..	137,325	65,015
Ukrainian S.S.R. ... ..	30,960	30,960
White Russian S.S.R. ... ..	5,568	5,568
Smolensk province ... ..	2,691	2,691
Leningrad province ... ..	6,435	2,500
Karelian Republic ... ..	469	150
Kalinin province ... ..	3,211	2,300
Kursk province ... ..	3,197	3,197
Moscow province ... ..	8,918	1,500
Toula province ... ..	2,050	1,400
Orel province ... ..	3,488	3,200
Crimean Republic ... ..	1,127	1,127
Rostov province ... ..	2,894	2,894
Voronezhskaja Oblast ... ..	3,551	2,500
Krasnodarski Krai ... ..	3,173	3,173
Ordzhonikidzski Krai ... ..	1,949	1,949
Stalingradskajaja Oblast ... ..	2,289	2,289
Dagestanskaja A.S.S.R. ... ..	930	—
Kabardino-Balkashskaja A.S.S.R. ... ..	359	—
Severo-Osetinskaja A.S.S.R. ... ..	329	—
Checheno-Ingushskaja A.S.S.R. ... ..	697	—
Azerbaidzhanskaja S.S.R. ... ..	3,210	—
Gruzinskaja S.S.R. ... ..	3,542	—
Armianskaja S.S.R. ... ..	1,282	—
Total of districts ... ..	92,319	65,015

## A NOTE ON KURTOSIS

By F. J. DYSON, B.A. Cantab.

STATEMENTS in statistical literature on kurtosis seem to be rather loose. Thus Yule and Kendall\* say: "We take as the standard value of  $\beta_2$  the number 3, for reasons which will appear when we study the so-called 'normal' curve. This curve is approximately of the shape given in Fig. 6.5, page 93. Curves with values of  $\beta_2$  less than 3 will, compared with this, be flat-topped, and are called *platykurtic* (πλατύς broad + κυρτός). Curves with values greater than 3 will be peaked more sharply, and are called *Leptokurtic* (λεπτός narrow + κυρτός). 'Student' gives an amusing mnemonic for these names: Platykurtic curves, like the platypus, are squat with short tails. Leptokurtic curves are high with long tails, like the kangaroo—noted for 'lepping.'" Then in a footnote they add: "These terms are due to Karl Pearson, and appear to have been given for the first time in *Biometrika*, vol. 4, 1905–6, pages 169 *et seq.* By a slip leptokurtosis is there inadvertently applied to distributions for which  $\beta_2 < 3$ ." The slip is repeated in the first edition of Aitken's *Statistical Mathematics*.†

Nowhere in the literature does there seem to be a precise statement of exactly what is true, and the following note is intended to make good the deficiency.

- (1) *A sufficient condition for one frequency curve to have a greater  $\beta_2$  than another*

Suppose two frequency curves

$$y = f_1(x) \qquad y = f_2(x)$$

to be given, both normalized, and with the same mean  $x = 0$  and the same standard deviation  $\sigma$ .

Let  $\mu_{13}, \mu_{23}; \mu_{14}, \mu_{24}$  be their respective third and fourth moments. Then a sufficient condition for  $\mu_{14} \geq \mu_{24}$  is that there should exist four abscissae,  $a_1 < a_2 < a_3 < a_4$ , such that

$$\text{when } \left. \begin{array}{l} -\infty < x < a_1 \\ a_2 < x < a_3 \\ a_4 < x < \infty \end{array} \right\} f_1 \geq f_2 \qquad \text{and when } \left. \begin{array}{l} a_1 < x < a_2 \\ a_3 < x < a_4 \end{array} \right\} f_1 \leq f_2$$

and  $(a_1 + a_2 - a_3 - a_4)$  and  $(\mu_{23} - \mu_{13})$  are *not* both strictly positive or both strictly negative (in particular that the curves should have equal skewness).

## PROOF

Suppose that this condition is satisfied.

Let  $\phi(x) = (x - a_1)(x - a_2)(x - a_3)(x - a_4) = x^4 - px^3 + qx^2 - rx + s$ . Then  $\phi(x)$  is positive and negative in the same ranges as  $(f_1 - f_2)$ . Therefore

$$\int_{-\infty}^{\infty} \phi(x)(f_1 - f_2)dx \geq 0.$$

\* Yule and Kendall, *An Introduction to the Theory of Statistics*, 11th edn. Griffin, London, 1937.

† Aitken, *Statistical Mathematics*, Oliver and Boyd, London and Edinburgh, 1939.

But, substituting for  $\phi(x)$ , this integral is:

$$\begin{aligned} & (\mu_{14} - \mu_{24}) - p(\mu_{13} - \mu_{23}) + q(\sigma^2 - \sigma^2) - r(0 - 0) + s(1 - 1) \\ & = (\mu_{14} - \mu_{24}) + p(\mu_{23} - \mu_{13}) \geq 0. \end{aligned}$$

But 
$$p(\mu_{23} - \mu_{13}) = (a_1 + a_2 + a_3 + a_1)(\mu_{23} - \mu_{13}) \leq 0.$$

Therefore 
$$\mu_{14} \geq \mu_{24}.$$

(2) Although the previous condition is sufficient, it is not, of course, necessary. It is not necessary even when both curves are unimodal and have a single inflexion on either side. The following example shows this.

Consider the two probability distributions

$$f_1(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}$$

and 
$$f_2(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2} \{1 + A(x^8 - 22x^6 + 116x^4 - 126x^2 + 3)\}$$

where  $A$  is a small positive constant.

Both  $f_1$  and  $f_2$  are normalized and symmetrical, and have the same mean 0 and standard deviation 1. Further, they each have only one point of inflexion between  $x = 0$  and  $x = \infty$ . This is well known in the case of  $f_1$ . For  $f_2$  we consider

$$\frac{d^2 f_2}{dx^2} = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2} \{x^2 - 1 + A(x^{10} + p)\},$$

where  $p$  is a certain polynomial of degree 4 in  $x^2$ .

$$\frac{d}{dx} \{x^2 - 1 + A(x^{10} + p)\} = x(2 + 10Ax^8 + Aq),$$

where  $q$  is a cubic polynomial in  $x^2$ .  $10x^8 + q$  is bounded below in the range  $0 < x < \infty$ . Hence we can choose  $A$  so small that

$$2 + A(10x^8 + q) > 0 \quad \text{when } 0 < x < \infty.$$

Then  $\frac{d^2 f_2}{dx^2}$  can vanish at most once between 0 and  $\infty$ . But  $\frac{d^2 f_2}{dx^2}$  is clearly positive when  $x$  is large and negative when  $x = 0$ . Therefore, as stated,  $f_2$  must have one, and only one, point of inflexion on either side of the mean, if  $A$  is sufficiently small and positive.

But  $f_1$  and  $f_2$  have the following properties:

$$\left. \begin{aligned} f_2 &> f_1 \text{ where } x \text{ is large} \\ f_2 &> f_1 \text{ when } x \text{ is near } 0 \end{aligned} \right\} \quad \dots \dots \dots (i)$$

The fourth moment  $\mu_4^{(1)}$  of  $f_1$  is 3.

The fourth moment  $\mu_4^{(2)}$  of  $f_2$  is  $\mu_4^{(2)} = 3 - 96A < \mu_4^{(1)}$ .

Thus the inequalities (i), together with the other conditions mentioned on  $f_1$  and  $f_2$ , are not necessarily incompatible with the inequality  $\mu_4^{(2)} < \mu_4^{(1)}$ .

It is interesting to note that the curves  $f_1$  and  $f_2$  cross one another *four* times on either side of  $x = 0$ .

I am indebted to Dr. J. O. Irwin for suggesting this problem for investigation.



## REPORT OF THE COUNCIL

*For the FINANCIAL YEAR ended December 31st, 1942, and for the SESSIONAL YEAR ending June 16th, 1943, presented at the ONE HUNDRED AND NINTH ANNUAL GENERAL MEETING of the ROYAL STATISTICAL SOCIETY, held at the house of the Royal Society of Arts, Adelphi, W.C.2, on June 22nd, 1943.*

THE Council have the honour to submit their One Hundred and Ninth Annual Report.

The roll of Fellows on December 31st, 1942, as compared with the average of the previous ten years, was as follows:—

	1942.	Average of the previous ten years.
Number of Fellows at end of previous year ... ..	1074	1059
Number lost by death, withdrawal, or default ... ..	69	59
Fellows elected or restored to the list ... ..	74	60
Number of Fellows on December 31st ... ..	1079	1060

In addition, there were 11 Honorary Fellows.

The Council regret to report that during the sessional year ended on June 22nd, 1943, the Society lost by death the undermentioned Fellows:—

	Date of Election.
*Balkrishna, Professor ... ..	1913
*Bonn, Sir Max J., K.B.E. ... ..	1905
pBrace, James ... ..	1921
cdp*Chapman, Samuel ... ..	1886
Chenhalls, Alfred T. ... ..	1926
cpd*Darwin, Major Leonard, Sc.D. ... ..	1897
cdp†*Flux, Sir Alfred W., C.B., M.A. ... ..	1893
*Haig, Edric W. ... ..	1903
Jarvis, William H. ... ..	1915
*Lees-Smith, Rt. Hon. H. B., P.C. ... ..	1904
d*Middleton, Sir Thomas H., K.B.E., C.B., M.A., F.R.S. ... ..	1907
cdpNewsholme, Sir Arthur, K.C.B., M.D. ... ..	1889
*Sanyal, Dr. S. M., M.A., M.Sc. ... ..	1921
White, Gilbert ... ..	1941
*Williams, Col. Sir Robert, Bt. ... ..	1888

\* Life Fellow

† Guy Medallist.

c Served on Council.

d Donor to the Library.

p Contributed to Proceedings.

The names of those lost by death are, all but one, those of Fellows of long standing, the majority of them Life Fellows.

In the list the name of Sir Alfred Flux stands out as that of a past President, an Honorary Secretary for many years, a contributor of many valuable papers, and a generous giver of his services to the Society throughout the forty-nine years of his Fellowship. Sir Alfred had been living in Denmark for some time, and the news of his death there in July, after a brief illness, came as a great

blow to the many friends who were hoping to welcome him here again after the war. An account of his academic and official career and of his work for the Society appeared in the *Journal*, Part II, 1942.

Another name in the list has appeared frequently in the Society's records—that of Sir Arthur Newsholme, formerly the Principal Medical Officer of the Local Government Board. His association with the Society, which began 54 years ago, was active and intimate until he left London after his retirement from office, and his interest in statistics continued until the end of his life. He served on the Council for several periods between 1908 and 1926 and read three important papers before the Society, in 1891, 1896, and 1906, the last written in collaboration with Dr. T. H. C. Stevenson. Sir Arthur was also a valued contributor to discussions of papers on vital statistics. An obituary notice appeared in the *Journal*, Part I, 1943.

Major Darwin was a Fellow for nearly 46 years; he served on the Council and read two papers before the Society, both on subjects connected with eugenics, which was one of his chief interests.

Sir Thomas Middleton, elected in 1907, was for many years one of the Society's most highly appreciated contributors to discussions on Agricultural subjects, on which he spoke with all authority and understanding derived from long experience and devoted study.

Mr. Samuel Chapman, in the course of his 57 years of Fellowship, served during various periods on the Council, and was especially active in trying to forward plans for the permanent housing of the Society. In latter years he was an invalid but continued to take a lively interest in statistics and in the Society's affairs.

Mr. James Brace, whose death occurred at a comparatively early age, was for some years in the Statistics Department of the Board of Trade. Until he left London in 1927 he was a regular attendant at the meetings and contributed to discussions. In 1931 he read a paper on "Statistical Analysis of Building Societies," published in the *Journal* (Vol. 94).

During the session 1942–43, the one hundred candidates named below have been elected Fellows of the Society:—

Barou, Noah, Ph.D.  
 Baxter, John.  
 Bishop, George Sydney.  
 Bone, Benjamin Arthur James, F.I.A.  
 Bowen, Ivor Ian.  
 Brooke, Eileen Minnie, M.Sc.  
 Buckmaster, Owen Stanley, Viscount.  
 Butler, Lt.-Col. Hugh D.  
 Care, Capt. Charles William.  
 Carne, William Alfred.  
 Cashmore, Frank Reginald.  
 Clementson, Joseph Rosslyn.  
 Coles, Eric Keith.  
 Cowan, Thomas Edward.  
 Darke, William Francis, Ph.D., B.Litt.,  
 B.Sc.

Davey, Reginald Charles Ward.  
 Davison, Joseph Edward.  
 Dobson, John Henry.  
 Dodds, Edward Charles, M.V.O., M.D.,  
 D.Sc., F.R.S.  
 El-Saaty, Hassan.  
 Endean-Rowe, Sydney John.  
 Franklin, William Ernest.  
 Friday, Frank Adzley.  
 Gaughan, Louis.  
 Gillender, Captain Hilton, R.E.  
 Gooda, William Graham.  
 Grainger, Paul Eveleigh.  
 Haddow, Hugh Paterson.  
 Hanby, Gordon, F.C.A.  
 Hardie, Charles Dunn.

Hart, David.	Puckette, Charles Clarke.
Innerarity, Edmund Constantine.	Pyett, Wilfred Bernard.
Jones, Arthur Emrys.	Robertson, Ronald Ernest.
Kaim, Peter K.	Roper, Daniel Herbert, F.C.I.I., F.C.I.S.
Kapoor, S. R., L.R.C.P., L.R.C.S.	Sarkar, N., M.A.
Kensit, George Robinson, B.A., F.I.A.	Signy, Joseph Maxwell.
Killick, Richard Edmund.	Silberman, L., B.Sc.
Kudlicki, Stanislaw.	Simpson, Gordon Leslie.
Lengyel, Aurel Eugen.	Skilton, Alexander Stuart Vernon.
Lessof, Elizabeth, B.Sc.	Slack, Margaret, M.Sc.
Lévy, Paul Michel Gabriel.	Smith, Charles Alexander, LL.M., F.C.A.
Leybourne, Grace Gwendoline, Ph.D.	Speirs, Ivie Alexander.
Macassey, Sir Lynden, K.B.E., K.C.	Starke, L. G. K., B.A., F.I.A.
MacClelland, Robert Alan Russell.	Steele, Arthur Robert Victor.
McLean, Mary Sullivan, M.A.	Swan, Albert William, B.A.Sc. (Toronto).
McVittie, William T.	Thompson, Alfred.
Maizels, Alfred.	Thomson, David Halton, M.A., M.Inst.-C.E.
Martin, Donald Beattie, F.I.A.	Tomski, Heinz-Werner, M.P.S., D.B.A.
Milligan, John Gordon Craig, B.Con.	Unwin, John, LL.B., F.C.A.
Monic, Boleslaw.	Vajda, Stefan, Dr.Phil. (Vienna).
Morrison, Reginald Campbell.	Vajda, Stefan.
Ogborn, Maurice Edward.	Vincent, John Joseph.
Opie, Oliver Reginald, B.Sc., A.M.Inst.-C.E.	Whetham, Edith Holt.
Ouchterlony of Kellie, Baron.	White, Bertram Alexander, B.Sc.
Pallot, Arthur Charles, M.B.E., B.Sc., M.Inst.C.E.	Williams, Thomas.
Parkinson, Harold.	Wilson, James Harold.
Pearce, Stanley Clifford.	Woodcock, Fred.
Perry, The Rt. Hon. Lord.	Worley, Antony Edward.
	Wortley, Glenn.

## Corporate Representatives.

Gross, Oscar,	<i>representing</i> the Economic Research Group (Unilevers).
Hughes, Collingwood,	<i>representing</i> the London Express Newspaper, Limited.
Jaffe, Herman,	<i>representing</i> the Norwegian Shipping and Trade Mission.
Krajewski, George, Szymkowiak, Wieslaw,	} <i>representing</i> the Polish Maritime Council.
Kronsten, Dr. Józef Aleksander, Różycki-Zamoyski, Tadeusz,	
Landau, Mathias Artur Georg, M.A.,	<i>representing</i> the Association for Planning and Regional Reconstruction.
Margulies, Oscar,	<i>representing</i> the Pallas Oil and Trading Company, Limited.
Neustaetter, Hannah,	<i>representing</i> the Trades Advisory Council.
Ording, Aake,	<i>representing</i> the Royal Norwegian Ministry of Supply and Reconstruction.
Turek, Lieut. Miroslav,	<i>representing</i> the Czechoslovak Ministry of National Defence.
Wharton, Allan Stuart	<i>representing</i> Philips Lamps, Limited.

The number of Fellows is now 1,056, compared with 1,050, in June 1942.

Ordinary Meetings were held, as in the last session, in March, April, May and June. The papers were:—

ELDERTON, SIR WILLIAM P., F.I.A., and M. E. OGBORN, F.I.A. The Mortality of adult males since the middle of the eighteenth century as shown by the experience of Life Assurance Companies. (March 16th, 1943.)

THOMPSON, R. J., C.B. The Future of Agriculture. (April 20th, 1943.)

Discussion on Post-war International Monetary Plans, opened by Mr. NORMAN CRUMP. (May 18th, 1943.)

SHIRRAS, Professor G. F. Methods of calculating the burden of taxation. (June 22nd, 1943.)

Mr. M. G. KENDALL's paper, "Oscillatory Movements in English Agriculture," was not read at a meeting but was published in the *Journal* with a written discussion.

The procedure adopted in the previous session with respect to candidates for election was continued; that is, approval by the Executive Committee was held to confer the main privileges of Fellowship pending formal election at a meeting. The 70 candidates so approved during the period July 1942 to March 1943, were duly elected at the March meeting.

Widespread disappointment was caused by the suspension of the Industrial Research Supplement, as was shown by numerous enquiries not only from all parts of this country but from Canada, Australia, New Zealand and the United States, where methods of statistical control of quality in production are being zealously studied and developed. Here, at home, the value of these methods has been increasingly recognised during the war, particularly in the production ministries. In course of practice, new developments occur and new problems arise, and in the late summer of 1942 it was decided that the Society should provide facilities for discussion by technical statisticians of statistical principles in relation to their special work. A war-time "Industrial Applications Group" of the Section was therefore formed for this purpose, in charge of a Committee under the Chairmanship of Professor E. S. Pearson. Admission to the meetings was for the time being to be open to any persons interested in the aims of the Group. Four meetings took place during the session and were successful in that the attendance was good and the discussions fruitful. All were held, by courtesy of E.L.M.A. Lighting Bureau at their premises in Savoy Street. The subjects discussed were as follows:—

1942.

- |               |     |   |
|---------------|-----|---|
| December 18th | ... | The relation between design tolerances and "control limits" in manufacture; opened by Dr. B. P. Dudding.                              |
| February 19th | ... | The study of material classified as defective; opened by Mr. Worley (Ministry of Supply).   |
| March 26th    | ... | Group Control Charts: Charts suited to watching production from groups of machines or from multi-head machines; opened by Dr. Sealey. |
| May 14th      | ... | Other applications of Quality Control Chart Technique; opened by Mr. Tippet.  |

An account of these discussions was given by Dr. Dudding in the *Journal*, Part I, 1943.

It is hoped to arrange for some meetings of the Group to be held in the North of England in order to facilitate the attendance of statisticians who are not often able to travel to London.

As a result of a suggestion made by Mr. Kendall in the paper he read before the Society in April, 1942, the Council resolved to set up a Committee "to consider and report to the Council upon the organisation of statistics in Government departments before, during and after the war, with special reference to 'the staffing of departments, the relations between departments, and the advantages and disadvantages of alternative schemes of post-war organisation.'" The Committee has held several meetings during the session but has not yet presented its report.

In October 1942 the Council was informed of the setting up by the Royal Institute of International Affairs of a Consultative Conference on Social and Economic Research "to promote contact between academic bodies and certain Government Departments in which economic investigations are in progress" and to prevent the overlapping of programmes. The objects include the compilation, undertaken by the National Institute of Economic and Social Research, of a classified list of work planned and in progress.

The Council was invited to participate in the work of the Conference and appointed Dr. Isserlis as representative.

In the year ended May 31st, 1943, 508 works were added to the Library, compared with 559 the year before. These figures exclude periodicals regularly received and a number of Parliamentary Papers. During the same period 2,805 volumes were borrowed by 975 Fellows, against 1,578 by 634 Fellows the year before.

The abstract of the Treasurer's Accounts, viz., the Statement of Income and Expenditure for the year 1942 and the Balance Sheet as at 31st December, 1942, together with the report of the Auditors thereon, are given in Appendices A and B (pages 368–371.)

Income at £2,922 was £410 greater than in 1941; annual subscriptions increased by £146 and sales of publications by £257. Expenditure also increased, by £213 to £2,848; this was more than accounted for by an increase of £220 in salaries and wages.

There was thus an excess of income over expenditure of £74 in 1942 as compared with a deficit of £123 in 1941. The Accumulated Fund of the Society at the end of 1942 amounted to £7,509.

The Fellows named below (nominated in accordance with Bye-law 14) are recommended for election as President, Council, and Officers of the Society for the Session 1943–44:—

*President*

Ernest Charles Snow, C.B.E., D.Sc.

*Council*

\*Sir Percy Ashley, K.B.E., C.B.

M. S. Bartlett, D.Sc.

H. Campion.

\*L. R. Connor, M.Sc.

Iris Douglas.

\*B. P. Dudding, O.B.E., Ph.D.

Major P. G. Edge, O.B.E.

Sir William Elderton, C.B.E., F.I.A.

\*Barnard Ellinger, C.B.E.

Dorothy P. Etlinger.

Sir George Epps, K.B.E., C.B., F.I.A.

C. Oswald George, Ph.D.

R. F. George.

R. G. Glenday, M.C.

P. N. Harvey, F.I.A.

\*R. G. Hawtrey, D.Sc.

David Heron, D.Sc.

A. Bradford Hill, D.Sc., Ph.D.

Leon Isserlis, D.Sc.

Professor J. H. Jones.

M. G. Kendall.

Lord Keynes, C.B., F.B.A.

Sir David Meek, C.I.E., O.B.E.

Professor E. S. Pearson, D.Sc.

Professor Arnold Plant.

George Rae, D.Sc.

Herbert W. Robinson, Ph.D.

\*L. H. C. Tippett.

Sir Sylvanus Vivian, C.B.

\*A. S. Windett.

Those marked \* were not Members of Council during the preceding Session.

*Honorary Treasurer*

David Heron, D.Sc.

*Honorary Secretaries*

Leon Isserlis, D.Sc.

A. Bradford Hill, D.Sc., Ph.D.

C. Oswald George, Ph.D.

On behalf of the Council,

W. H. BEVERIDGE,

*President.*

E. C. SNOW,

L. ISSERLIS,

A. BRADFORD HILL,

} *Hon. Secretaries.*

June 8th, 1943.

## APPEN

## STATEMENT OF INCOME AND EXPENDITURE

EXPENDITURE.					
1941			1942		
£	s.	d.	£	s.	d.
			£	s.	d.
380	0	0	380	0	0
212	9	10	206	17	7
808	10	6	1,028	2	10
189	0	0	189	0	0
35	12	9	54	11	1
—	—	—	1	17	3
35	12	9	56	8	4
496	1	6	455	18	9
94	15	5	109	11	9
590	16	11	565	10	6
13	17	8	38	8	8
17	15	6	41	15	0
31	13	2	80	3	8
21	1	2	20	17	6
31	3	2	39	18	7
46	15	2	48	13	2
12	14	5	7	14	1
36	15	0	36	15	0
235	14	1	129	7	6
—	—	—	46	2	2
—	—	—	12	12	0
			2,848	2	11
—	—	—	74	5	2
2,635	6	2	2,922	8	1
52	10	0	115	10	0
£2,687	16	2	£3,037	18	1

## DIX A.

FOR THE YEAR ENDED 31st DECEMBER, 1942

INCOME.									
1941					1942				
£	s.	d.					£	s.	d.
1,488	18	0	Annual Subscriptions	...	...	...	1,634	17	0
448	1	7	Sales of Journal and Reprints	...	...	...	664	6	8
3	10	0	Journal Advertisements	...	...	...	1	15	0
68	18	7	Sales of Supplement	...	...	...	108	8	7
3	6	7	Sales of other Publications	...	...	...	4	9	4
50	0	0	Contribution from Royal Economic Society	...	...	...	50	0	0
449	8	5	Dividends and Interest (gross)	...	...	...	458	11	6
<hr/>									
2,512	3	2							
<i>Balance carried to Accumulated Fund: Excess of Expenditure</i>									
123	3	0	<i>over Income for the year 1941</i>		...	...	...	—	—

2,635 6 2

2,922 8 1

52 10 0 Life Compositions .. ...

115 10 0

£2,687 16 2

£3,037 18 1



## APPEN

## BALANCE SHEET AT

1941				1942			
£	s.	d.		£	s.	d.	
			65 2 0				81 18 0
			168 18 6				210 14 2
			248 3 10				214 18 2

## DIX B.

31ST DECEMBER, 1942

## ASSETS.

1941						1942		
£	s.	d.	£	s.	d.	£	s.	d.
Investments, at cost or under:—								
			£10,527 12s. 3d. 2½% Consols					
5,580	0	0	(Guy Bequest) ...					
1,185	0	0	£2,236 11s. 3d. 2½% Consols					
1,299	0	0	£1,841 3½% Conversion Loan					
490	0	0	£500 3½% War Loan					
			£1,169 17s. 6d. 3% Local					
800	0	0	Loans Stock ...					
			£666 4% 2nd Prefd. Stock,					
			London and North-Eastern					
100	0	0	Railway ...					
			£266 5% Prefd. Ord. Stock,					
			London and North-Eastern					
25	0	0	Railway ...					
			9,479	0	0			
(Market value, December 31st, 1942, less Interest accrued, £14,392)								
Interest accrued on Investments								
			(gross) ...					
			101	19	9			
			318	9	11			
Cash at Bank and in hand ...								
						194	14	8
Arrears of Subscriptions recoverable (estimated) ...								
			63	0	0			
Sundry Debtors and amounts paid in advance ...								
			51	7	9			
			197	6	9			
Stock of Journal Paper ...								
						290	2	0
						297	8	11
			10,211	4	2			
Building Fund:—								
			£1,040 5s. 1d. 3½% Conversion Loan ...					
			953	3	9			
(Market value, December 31st, 1942, £1,147)								
Frances Wood Memorial Fund:—								
			£600 4% Preference Stock,					
			London, Midland and Scottish Railway ...					
300	0	0						
			(Market value, December 31st, 1942, £459)					
			Post Office Savings Bank					
			Deposit ...					
99	4	9						
1	16	0						
			401	0	2			
			£11,565	8	1			
						£11,843	18	7

## REPORT OF THE AUDITORS

We have examined the foregoing Statement of Income and Expenditure and Balance Sheet with the Books and Records of the Society. We have verified the Investments and Cash appearing in the Balance Sheet. We report that the above Balance Sheet is, in our opinion, properly drawn up so as to exhibit a true and correct view of the state of the affairs of the Society, according to the best of our information and the explanations given to us, and as shown by the Books and Records.

PLENDER, *Chartered Accountant*. Auditor.  
 H. J. BENTLEY } Honorary  
 C. OSWALD GEORGE } Auditors.

PROCEEDINGS OF THE ONE HUNDRED AND NINTH ANNUAL GENERAL MEETING  
OF THE ROYAL STATISTICAL SOCIETY, HELD AT THE LONDON SCHOOL OF  
HYGIENE AND TROPICAL MEDICINE ON TUESDAY, JUNE 22ND, 1943.

THE CHAIR was taken by the ex-President, MR. H. LEAK, at 5 p.m.

THE HONORARY SECRETARY read the notice convening the meeting.

He then announced that the names of 27 defaulters were to be removed from the roll of Fellowship under by-law No. 9.

A ballot was taken for the election of the President, Council and Officers for the Session 1943-44, Mr. W. J. Williamson and Mrs. Neustaetter being appointed scrutineers. As a result the Chairman announced that all those nominated had been elected to the several offices.

The Chairman presented the Report of the Council for the financial year 1942 and the Session 1942-43, drawing attention to some of its principal features. He then moved that the Report be adopted and printed in the *Journal*. Mr. G. B. Hey seconded the motion, which, on being put to the vote, was carried unanimously.

A cordial vote of thanks to the President, the Honorary Officers and the Council for their services during the past year and their accomplishment in spite of the war-time difficulties, was proposed by Mr. Vibart, seconded by Dr. Irwin and carried unanimously.

The Proceedings then terminated.

## CONTENTS.

## REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

	PAGE		PAGE
1.— <i>Tippett (L. H. C.). Statistics</i> .	373	3.— <i>Kulischer (E. M.). Displacement of Population in Europe</i> .	375
2.— <i>Notestein (F. W.) and others. Future Population of Europe and the Soviet Union</i> .	373	4.— <i>Liepmann (Kate K.). Journey to Work</i> .	376

1.—*Statistics*, by L. H. C. Tippett. (The Home University Library. Oxford University Press. 1943. 6½" × 4½". 184 pp.

A statistician writing an introduction to his subject designed to interest new readers is assailed by three temptations. The first is to "feature" diagrams or tables of data which he thinks "the public" will enjoy. The next is to drop into algebra—*elementary* algebra, of course—which guarantees the scientific respectability of his subject. The last is to be vaguely eloquent on the past, present and future triumphs of statistics in solving important problems.

Mr. Tippett has stoutly resisted the Evil One. There *are* some diagrams and tables—but very few; there is no algebra at all; far from boasting of triumphs, Mr. Tippett confesses his early faith that modern methods of statistical analysis "seemed to have unlimited power to penetrate the secrets of nature" has waned. This asceticism is a necessary but not a sufficient condition for the production of a good primer. But Mr. Tippett has also a sense of humour, a sense of literary form and common sense; he is, in fact, of the Yulean School. The result is that one could hardly do better than put the booklet into the hands of any intelligent person who wants to know what statistics is (or are) about. We should select the chapter on Statistical Reasoning as a model combination of wit and wisdom; its examples of propaganda statistics are admirably chosen, those of post-1939 vintage painfully remind us that virtually all statistics of war in all countries are propagandist, but a pre-war example may be quoted. "It is men of exceptional experience who are buying X . . . cars to-day." "87 per cent. of X . . . cars to-day are bought by men who have owned six other makes of car before." Mr. Tippett comments: I suppose it is unlikely that as many as 87 per cent. of all makes of car are bought by such veterans as those mentioned in the advertisement, and the purchasers of X . . . cars are probably exceptional, but they may be exceptional in their fickleness—and do the makers of the X . . . cars wish us to believe that they do not get many repeat orders? These are possible interpretations of the data." Another possible interpretation is that the X . . . cars were not very low-priced, and, statistically speaking, salaries increase with age.

Mr. Tippett does well to insist that "statistical laws have nothing to do with individuals." This ought to be a truism, but one often meets with ostensibly statistical classifications so fine that the tabulation will be of individuals, and even oftener with complaints that regression equations are not very useful for picking individual scholarship boys.

Mr. Tippett's book will encourage readers likely to make good statisticians and discourage those who want an up-to-date magic. That is high praise.

M. G.

2.—*The Future Population of Europe and the Soviet Union; Population Projections 1940-70*. By Frank W. Notestein and others. Princeton University. League of Nations. Allen and Unwin. 1944. 5½" × 8½". 315 pp. 15s.

If numbers count—and who can doubt it during a world war?—this is an alarming book. Europe has a declining population compared with the rest of the world, and North-Western Europe has a declining population compared with the rest of the Continent. So the countries with a higher standard of living

are losing ground to those with a lower standard. In 1910 Europe had about 340 million people, or 20 per cent. of the world's total; in 30 years, as a result of declining growth here and of rapid increase elsewhere, Europe's part of the total fell to 18 per cent. The chief recent factors have been, first, a lower mortality rate, and, second, a lower fertility rate. About the year 1930 Ireland and the Netherlands were the only countries in North-West Europe with a fertility rate high enough to yield a continuous growth. In France and Belgium the rate was 5-10 per cent. below the level required to maintain a stationary population; in England it was 10 to 20 per cent. below, and in Germany (surprisingly) it was 23 to 34 per cent. below this level.

In Southern and Eastern Europe the situation was very different; although rapid declines in mortality were matched by declines in fertility, the net reproduction rate remained high. Italy, the Balkans and Poland had rates rising from 1.16 to 1.48. In Russia we find the amazing rate of 1.60, which means an increase of more than 60 per cent. in a generation. Thus the war losses are falling partly on peoples still in the growth stage; in the north-west, however, the outlook is alarming. Even without the war, the north-west countries could have avoided falling numbers only by a rise in fertility or by immigration. As for the future, all predictions must be made subject to conditions remaining unchanged; they do not take account of frontier changes or of migrations, or, indeed, of the effects of the war. Our authors find that there was throughout Europe "a universal and substantially unbroken decline in fertility from before the beginning of this century up to 1933; between that date and the outbreak of the war substantial increases occurred in many parts of Western Europe." This change may be explained by the trade depression and the following recovery; in Germany Nazi propaganda helped a rise from the low figure of 14.7 in 1933 to 20 in 1940, though even here the better employment was a big factor.

Probably the rising trend is not permanent. Modern social and economic influences work against large families; these have been extending into the lower economic groups and the rural populations. Another alarming fact noticed by our authors is "the rapid ageing projected for the male population of England and Wales" in 1955 and 1970; and as these ages depend on the ages of existing groups, the forecasts can only be prevented from coming true by mass emigration or some huge catastrophe. Again, the increase in the older ages "is sharply accentuated by a somewhat startling decrease projected for the child population," but in this case the forecast may be upset by Government action over Family Allowances and by appeals to patriotism or group loyalty. War conditions favour large families by limiting spending in many usual directions while encouraging it when for the benefit of children. But part of the trend cannot be reversed: "The parents of 1960 are now living; their numbers can be significantly increased only by heavy immigration."

One cause of past and present trends is to be found in the Industrial Revolution, which "has been associated with rapid population growth wherever it has been experienced." As the Revolution began in Western Europe, the growth in numbers started here also and continued through the nineteenth century; "in general, this growth was achieved by reduction of the death rate rather than through a rise in births." After 1900 the death rate declined precipitously all over Europe. Birth rates followed a different course. Only in France did the decline start as early as 1820; "in the rest of Europe it did not commence until after 1870"; then it dropped precipitously, faster even than the death rate ever had.

As Mr. Loveday, Director of the Economic Section of the League of Nations, says in a preface, this volume is the work of a team of five in the Office of Population Research in Princeton University, with Professor F. W. Notestein as its leader. They must have devoted much time to their investigations, as is clear from the tables, graphs and plans, as well as from the facts recorded. Seven shaded maps show the actual population movements in the countries of the Continent between 1900 and 1940, with the predicted or "projected" changes up to the year 1970. No one who studies these maps can fail to be profoundly

interested in the projected numbers for the various countries between now and the year 1970. One map, or plan, gives the year when the maximum population for each country may be expected. Though France passed this date in 1940, England should reach its maximum in 1945, Scotland in 1955, Ireland in 1965-70. Germany's peak year is 1955, the same year being predicted for Norway and Finland. Spain may reach a maximum in 1965, but most countries will wait until the last year of the period—1970—e.g., Russia, Italy, Poland, Greece, Jugoslavia, and Bulgaria.

All these "projections" take no account of the actual and possible effects of the present war; "the greatest losses may still be in the future." Yet war has more than one effect on population; in addition to losses in battle and on service, there is an "increase in disease and death associated with the strain of war effort," other influences are under-feeding, epidemics, even famines. Some attempt is made to estimate the losses of the last war from all causes, including deficit of expected births. From this estimate it appears that for all Europe outside Russia the total losses were 22.3 millions, only two-sevenths of this total are put down to military losses, the "deficit of births accounts for nearly twice as many losses," and "excess civilian deaths over age 1" are reckoned at 5 millions. For Russia a rough guess puts the total losses at 26 millions, military losses being only from  $1\frac{1}{2}$  to 2 millions.

Possibly "civilian deaths in the present struggle will exceed those in the last war." Jews have been singled out for ruthless extermination, a larger area has been "subjected to the disorganizing influence of defeat and enemy occupation." On the other hand, disease and epidemics may be more efficiently controlled; less, too, may be expected from birth deficits. If war operations are of about the same magnitude as in 1914-18, our authors would put the population deficit at a lower figure than in the last war.

Apart from wars, what of the future? Professor Notestein warns us that the dangers of over-population have not disappeared, "the Malthusian controls of hunger, privation, pestilence, and war are the principal checks to growth."

Eastern Europe "already faces the fact of over-population in relation to developed resources." For lack of emigration, half the natural increase of 20 millions "had to be absorbed on the land." Yet the yields per acre of cultivated land in Poland and the Balkans "are markedly below those of France and particularly of Germany." Emigration and industrialization appear to be the only remedies.

On the other hand, the declining countries need immigrants, especially young men; our authors expect "measures calculated to raise the birth rate" after the war. Yet they do not think that economic provisions for children will have much effect, since "the classes in the most favoured economic positions have the fewest children." In fact, "wants increase more rapidly than incomes," and "the real economic deterrents to large families are greater in the middle income groups." No doubt the birth rate might be stimulated by appeals to nationalistic sentiment; but our authors fear that no policy would succeed except a combination of inducements "consonant exclusively with totalitarian ideals."

J. E. A.

3.—*The Displacement of Population in Europe.* By Eugene M. Kulischer. International Labour Office. Studies and Reports. Series O (Migration) No. 8. Montreal. 1943. 9" x 6". iv + 171 pp. 4s.

The effects of the present war on the distribution of population in Europe have been immense. The German policy of conscripting for labour service in Germany a great part of the able-bodied nationals of the occupied countries has led to mass migration whose reversal will set a major problem to the allies after victory has been secured. The present study, which Professor Kulischer has carried out for the International Labour Office, is therefore most timely. He has studied and co-ordinated most of the sources from which quantitative estimates of the extent of the migration movement can be made, and has painted a picture of the situation as it existed at the end of 1943.

The study is divided into three parts. The first deals with migration movements of the German people, the second with the movement of non-German populations, whilst the last is concerned with labour conscription by Germany. The analysis relates to the pre-war period as well as to the effects of war. The story begins with the resettlement of Germans living in the Balkans and the Baltic States; it ends with the exodus from the bombed German towns and the influx of prisoners of war from the East. It is extremely difficult to summarize the figures; indeed, the author has been as brief as anyone could be. To disentangle the effects of these movements would require more detailed figures which in many cases are not yet available. We must therefore regard this book as an interim report.

The picture that emerges is one of indescribable human suffering which even the author's dry figures cannot wholly conceal. Jews, Poles, Russians, and settlers of German origin were removed at very short notice from places in which their families had been settled for generations. Of the non-Germans few were able to retain their property, the greater part of which was confiscated. Indeed, in reading this study, one is struck by the contrast between the ruthless procedure of the Germans, and the comparatively civilized methods used by some of their satellites. Altogether, nearly 23,000,000 people were transplanted between 1941 and the middle of 1943, and no doubt the figure has risen considerably since that date.

The only criticism that one can make is that Mr. Kulischer is occasionally a little too ready to accept numerical estimates from sources which one would expect to be biased. In view of the flood of propaganda to which we have been subjected from all quarters during the war, it will not be surprising if some of the smaller details in the book have to be revised in the future. But the broad conclusions are not invalidated, and the book will be an indispensable work of reference to all those concerned with the social and economic history of the war.

E. G.

4.—*The Journey to Work, its Significance for Industrial and Community Life.* By Kate K. Liepmann, Ph.D. London: Kegan Paul, 1944. 8½" × 5½". xii + 199 pp. 15s.

This book covers a wide field; it deals with the blessings and the hardship which the daily journey involves for an ever-increasing section of the population. The treatment is most thorough and scholarly. The author has tackled the problem in a way which shows the many implications of the title. She explores the conditions not only in this country, but also in continental countries, where she has made studies of these and related subjects. The book throws light on the social, economic, and demographic effects of large-scale travelling from home to place of work. Professor A. M. Carr-Saunders points out in the Foreword that "there are only a few inventions of which it can be said they have brought nothing but blessings. Concerning some, indeed, a case can be made out for holding that they have proved to be little else than curses; but most inventions, it is clear, have had both good and evil results. Such is the position of the invention of mechanical transport. . . ."

Dr. Liepmann is extremely cautious in weighing up the advantages and disadvantages connected with travelling to and from work; she is well aware that the railway and other travelling facilities have reduced the risk of unemployment and have thus led to more independence in regard to the choice of work and where to live; but she by no means overlooks the limitations of the workers' freedom in this respect.

Every detail connected with travelling to work comes under observation. On the one hand the stress of the journey and the loss of time it entails, is discussed, and on the other the widening of the labour market. A whole chapter is devoted to the implications of Town Planning; another chapter deals with statistical investigations, which include enquiries made by large private firms, such as Carreras, Achille Serre, Standard Telephones and Cables, London; the Austin Motor Company and the Dunlop Rubber Company, Birmingham;

Morris Motors, Oxford. Among investigations relating to other countries, the Swiss, German, Dutch and American data are extremely valuable for comparison with this country; the author's conclusions are drawn cautiously but well.

The five-day week and the staggering of working hours are some of the relief measures discussed; but it is impossible to go into the details of the interesting materials presented.

Two main questions come into one's mind whilst reading it. The first is what result could be expected if the motor-car should become as popular in this country as it is in the United States? It would undoubtedly lessen the strain of the journey and make living outside the precincts of the town a real blessing, but the next requirement would be the expansion of roads, and perhaps the creation of roads to be used exclusively for motor traffic. In a research undertaken by the United States Department of Commerce, it was found that in 14 out of 64 American cities under review, over one-half to nearly two-thirds of all principal earners used private cars to get to work; in 38 towns, 30 to 50 per cent. travelled by car; in 11 towns, 20 to 30 per cent.; and in only one town there were less than 20 per cent. car users. In this country (in June, 1937) 13.8 per cent. of those who were employed by the Austin Motor Company, Birmingham, came by private car, but, as the author remarks, this percentage would probably be found only among employees of a works manufacturing motor-cars.

The second question is this: if the railways were to be taken over by the State, could not a policy be envisaged which would be governed by other than chiefly economic considerations? For instance, there might be quicker trains for workers, thus shortening the journey, and more frequent trains, which might prevent over-crowding; the hours of workmen's trains might be extended and cross-country travelling might be facilitated.

The book is a most valuable study and is to be highly recommended to all who are interested in this problem.

M. J. E.



## STATISTICAL NOTES

## (1) BRITISH OFFICIAL STATISTICS

COMPARED with the year 1942 there was an increase in 1943 of 2.1 per cent. in the average of general wholesale prices as measured by the Board of Trade index-number. Food and tobacco prices rose 1.5 per cent. and prices of industrial materials and manufactures 2.4 per cent. Advances in prices were most considerable for coal (8.6 per cent.) and for the group of chemicals and oils (7.6 per cent.). There was a decrease of 5 per cent. in the cereals group and of 3 per cent. in that of cotton. The latter decrease was caused by a reduction of 1d. per lb. made in the price of raw cotton to compensate for the increased cost of spinning and manufacturing due to advances in wages. Fluctuations in the index-numbers for the remaining groups were not considerable, but there were appreciable changes in the prices of some articles comprised in the groups. Tobacco prices advanced rather more than 20 per cent., owing to the increased duty, and sugar for domestic use was increased 1d. per lb. There was also an advance of about 19 per cent. in the average allocation price of tea. The large advances in the prices of ground-nut oil (18 per cent.) and palm-kernel oil (35 per cent.) caused a rise of over 20 per cent. in the price of standard household soap. The price of rubber advanced 31 per cent., mechanical wood pulp 15 per cent. and sisal 12 per cent. On the other hand, there was a decline in the price of malting barley (20 per cent.) and there was a decrease in the price paid by millers for imported and home-grown wheat (6 and 5½ per cent.).

The table below gives the Board of Trade index-numbers of wholesale prices for the last four months of 1943 with the percentage changes compared with earlier years.

Date	Total Food	Total not Food	All Articles	Basic Materials (excluding Fuel)	Intermediate Products	Manufactured Articles	Building Materials
Sept. 1943	158.8	164.7	162.9	175.2	171.9	155.9	150.4
Oct. "	157.3	164.9	162.5	174.9	172.4	156.0	150.2
Nov. "	157.2	165.3	162.7	176.0	172.5	156.4	150.6
Dec. "	158.3	165.7	163.4	177.6	172.5	156.5	150.6
Dec. 1942	159.0	162.0	161.3	169.9	171.2	153.7	147.7
" 1941	150.5	158.4	155.9	170.5	167.7	150.3	141.8
" 1940	144.5	150.4	148.6	158.2	160.7	141.3	132.8
" 1939	118.1	124.3	122.3	135.0	125.0	122.0	110.3
Aug. "	90.4	102.2	98.1	91.5	104.0	108.7	104.1
Percentage increase in Dec. 1943 over—	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Dec. 1942	0.5*	2.3	1.3	4.5	0.8	1.8	1.9
" 1941	5.2	4.6	4.8	4.2	2.9	4.1	6.2
" 1940	9.6	10.2	10.0	12.3	7.3	8.5	13.4
" 1939	34.0	33.3	33.6	31.6	38.0	28.3	36.5
Aug. "	75.1	62.1	66.5	88.0	65.7	44.0	44.7

\* Decrease.

Since the commencement of the war the general level of wholesale prices had advanced 66½ per cent. by the end of 1943. Food prices had risen 75·1 per cent. and industrial materials and manufactures 62·1 per cent. As regards the group index-numbers, cereals had risen in price 101·2 per cent., food and tobacco other than cereals and meat 81·6 per cent., wool 78·2 per cent., cotton 68·3 per cent., other textiles 79·7 per cent., and basic materials (excluding fuel) 88 per cent. The smallest advance (25·2 per cent.) was in the prices of non-ferrous metals, but all of these metals except tin have been controlled since the outbreak of war, both as regards prices and supplies.

The figures for some other British index-numbers of wholesale prices and that of the United States Bureau of Labor are shown below.

Date	Board of Trade (1930 = 100)	Economist (1937 = 100)	Statist (1866-77 = 100)	The Times (1913 = 100)	United States Bureau of Labor (1926 = 100)
Sept. 1943 ... ..	162·9	114·3	154·6	177·2	102·9
Oct. " ... ..	162·5	113·6	153·7	176·7	—
Nov. " ... ..	162·7	113·5	153·9	177·6	—
Dec. " ... ..	163·4	113·7	153·9	177·6	—
Dec. 1942 ... ..	161·3	112·7	152·2	176·8	100·6
Aug. 1939 ... ..	98·1	70·3	90·4	114·5	74·8
Percentage increase in Dec. 1943 over—					
Dec. 1942 ... ..	0·5 +	0·9	1·1	0·5	—
Aug. 1939 ... ..	75·1	61·7	70·2	55·1	—

\* Decrease.

There were few changes in the *retail prices* of the articles of working-class consumption which are included in the cost-of-living index-number of the Ministry of Labour and National Service. There were increases of 4d. per lb. in the price of tea and of 1d. per lb. in the prices of sugar, with seasonal variations in the prices of milk and potatoes. On the other hand, there was a continued decline in the prices of clothing and clothing materials due to the increasing sales of "utility" clothing and clothing materials at prices appreciably lower than those of non-utility articles of corresponding quality. The decline in the clothing index-number began in the latter half of 1942. Among the miscellaneous articles of expenditure there was a considerable advance (17 per cent.) in the prices of tobacco and cigarettes owing to the increased duty and an advance of 1d. per lb. in the retail prices of soap. Prices of domestic ironmongery, brushes and similar articles also continued to rise. The net result, however, of all these changes was to leave the general index-number at the same level on January 1st, 1944, as it was on January 1st, 1943.

Since the beginning of the war the general index-number had risen 44 points or about 28 per cent. Food prices have risen 22 per cent., rent and rates 1 per cent., clothing 64 per cent., fuel and light 34 per cent. and miscellaneous items 63 per cent. It should be noted that non-utility clothing and some of the articles included under "other items" are subject to purchase tax. The follow-

ing table gives the index-numbers for the various groups for the later months of 1943.

(Prices at July 1914 = 100)

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items *	Total
Sept. 1st, 1943 ...	166	164	345	244	291	198
Oct. 1st, „ ...	168	164	340-345	244	291	199
Nov. 1st, „ ...	168	164	340-345	244	291	199
Dec. 1st, „ ...	168	164	340-345	244	291	199
Jan. 1st, 1944 ...	168	164	340-345	244	291	199
Jan. 1st, 1943 ...	164	164	370	244	268	199
Sept. 1st, 1939 ...	138	162	205-210	180-185	180	155
Percentage increase at Jan. 1st, 1944, over—						
Sept. 1st, 1939 ...	22	1	64	34	63	28

\* Soap, brushes, pottery, domestic ironmongery, fares, tobacco, etc.

The comparatively moderate increase in the general index-number is due, of course, to the Government's control of the retail prices of many articles and the subsidization of essential goods and services. The index-number is based on the retail prices at July 1914 of the principal articles of working-class consumption combined in accordance with their then relative importance: "no allowance has been made for any change in the standard of living since that date or for any economies or readjustments in consumption and expenditure since the outbreak of war."

The annual *index-number of agricultural prices* calculated by the Ministry of Agriculture shows that the rising tendency which was a feature of each of the years 1940, 1941 and 1942 was somewhat checked in 1943, the index in the latter year recording an increase of only two points on the average over 1942.

During the three years 1937-39, the general index-number was practically stationary at 90½; in 1940 it rose to 125, in 1941 to 150½, and in 1942 to 161, a total increase of 78 per cent. In 1943, however, the index was nearly stationary, moving only from 161 to 163. The figures for 1943 are provisional, as certain adjustments have still to be made in the prices of some of the commodities. Allowance has been made in these calculations for Government subsidies.

Base 1927-29 = 100

	1939	1940	1941	1942	1943
Cereals and farm crops ...	91½	124½	153½	183½	177
Livestock and livestock products ...	90½	121½	137	150	151½
Fruit, vegetables and glasshouse produce ...	88½	145½	228	188	203½
General index ...	90½	125	150½	161	163

There was naturally appreciable variation between the different commodities, as can be seen to some extent by comparing the figures for the three groups into

which they can be divided. The products included under the heading "cereals and farm crops" all showed a rise in 1942 as compared with 1941, the most noticeable being barley, the index-number for which was no less than 354 against 251 in the earlier year; in 1943 it declined to 273, but even at that level the increase in the price of barley during the war has been proportionately higher than that of any other crop. The general average for this group was somewhat less in 1943 than in 1942, owing to the lower price of barley, though this was somewhat counterbalanced by upward movements in most of the other crops.

The average change in the livestock group was insignificant, and it will be seen that the index of this group has increased much less since 1939 than has been the case with the farm crop group. This is reflected in the individual products, none of which shows very exceptional increases; milk, which is the principal single commodity, increased from 158 in 1941 to 175 in 1942 and to 178 in 1943, figures which may be compared with 102 in 1939.

The fruit and vegetable index was higher in 1943 than in the preceding year, though less than in 1941. Owing to their smaller aggregate value, fruit and vegetables affect the general index less than the products in the other two groups.

Comparison with the figures ruling in the last war shows that the 1943 index of 163 practically corresponds with the average for the year 1918. In that year the old index of agricultural prices, adjusted to a basis corresponding with the present series of index-numbers, stood at 160.

The state of *employment* remained very good during the whole of 1943. There was a decline of about 20,000 in the numbers of unemployed on the registers of Ministry of Labour and National Service in Great Britain between January 1943 and January 1944, but even at the earlier date the numbers were insufficient for the day-to-day demands of industry, the workpeople on the registers being almost entirely those in the process of changing jobs, women about to enter industry for the first time, and juveniles to a large extent school-leavers waiting to be placed in their first jobs. There is an unsatisfied demand for labour in most trades. In addition to the numbers recorded on the registers, there were at January 17th, 1944, 18,132 men classified as unsuitable for ordinary industrial employment and 555 women classified as unsuitable for normal full-time employment. Of the 22,860 females registered as wholly unemployed, 893 were classified as unable for good cause to transfer to another area.

The numbers recorded as unemployed in Great Britain at quarterly intervals are given below:

Date	Wholly Unemployed	Temporarily Stopped	Persons Normally in Casual Employment	Total	Males	Females
April 12th, 1943 ...	76,769	1,312	2,010	80,091	53,838	26,253
July 19th, " ...	71,129	1,118	1,011	73,258	50,236	23,022
Oct. 18th, " ...	72,253	732	951	73,936	49,809	24,127
Jan. 17th, 1944 ...	76,674	1,417	946	79,037	51,294	27,743
Jan. 18th, 1943 ...	93,708	3,114	2,195	99,017	61,709	37,308
Jan. 12th, 1942 ...	170,862	14,736	9,250	194,848	116,464	78,384
Jan. 13th, 1941 ...	521,888	152,381	21,837	695,606	371,695	323,911
Jan. 15th, 1940 ...	1,219,503	249,723	49,670	1,518,896	1,079,048	439,848
Aug. 14th, 1939 ...	968,108	211,978	51,606	1,239,692	947,099	284,593

There were 1,785 *trade disputes* in the United Kingdom in 1943, involving stoppages of work, and 1,810,000 working days were lost in consequence of these disputes. The number of workpeople affected was 559,000, of whom 104,000 were not directly involved in the disputes, but were thrown out of work at the establishments affected. Nearly half the working days lost (890,000) occurred in the coal-mining industry, about one-third (574,000) in the engineering and shipbuilding industries and one-tenth in transport working. The number of working days lost by disputes during 1943 was greater than in any year since 1937.

In 1943 there was an aggregate net increase of £1,351,000 in the weekly full-time *rates of wages* of about 6,200,000 workpeople, with but a slight decrease in weekly working hours, as compared with a net increase in 1942 of £1,600,000 to six and a half millions, £2,100,000 to eight millions in 1941 and £2,200,000 to eight millions in 1940. These increases are exclusive of changes in the wages of agricultural workers, Government employees, domestic servants, shop assistants and clerks. The Ministry of Labour estimates that at the end of 1943 the average level of full-time weekly *rates of wages* in all industries (including agriculture) for which information is available was between 4 and 5 per cent. higher than at the end of 1942 and about 38 or 39 per cent. above the level at the beginning of the war. In the above figures no account has been taken of the large increases in *average earnings* due to fuller employment, overtime working and the extension of the system of payment by results. Such average earnings at intervals from July 1940 have been obtained by the Ministry of Labour in practically all industries except coal-mining and railway service. The returns received have covered about 55,000 establishments and over 6,000,000 workpeople. Earnings of clerks, shop assistants, travellers, typists, and salaried persons generally have been excluded, as also were those of outworkers working at home in materials supplied by the employer. The earnings of foremen, transport workers, warehousemen, etc., have, however, been included.

The following table shows the average weekly earnings in October 1938 and in July 1943 in the principal industrial groups, together with the percentage increases over the earnings in October 1938 of the earnings at each July since the beginning of the war.\* Very little change in the wages position took place from October 1938 to August 1939.

The average earnings in the industrial groups and in the industries taken together have been weighted according to the estimated numbers employed in the various trades constituting the groups.

As in previous censuses, the average weekly earnings of men (skilled and unskilled) was highest in motor vehicle and aircraft manufacture (153s. 10d.) and in shipbuilding and repairing (143s. 1d.). In marine, electrical, in general engineering, in steel smelting, etc., and in non-ferrous metal manufacture, earnings were between 130s. and 140s. per week, as also were those in scientific instrument making and in Government industrial establishments. Earnings were lowest (between 80s. and 100s.) in most of the textile and clothing industries. Women's earnings were highest in Government industrial establishments (81s. 1d.), in aircraft manufacture (79s. 2d.), non-ferrous metal manufacture (72s. 2d.), and shipbuilding (71s. 11d.), and lowest (under 50s.) in the textile industries, flax, jute, hemp, etc., and lace.

\* Similar figures for January 1942 and January 1943 were obtained by the Ministry, see pp. 179-180 of *Journal of Royal Statistical Society*, Part II, 1943.

Industry group	Average weekly earnings in—				Percentage increase over Oct. 1938 of average weekly earnings in—			
	Oct. 1938		July 1943		July 1940	July 1941	July 1942	July 1943
Iron, stone, etc., mining and quarrying ... ..	s. 56	d. 8	s. 91	d. 7	per cent. 22.1	per cent. 38.8	per cent. 48.8	per cent. 62
Treatment of non-metallic minerals, etc., products ... ..	61	0	97	10	26.1	38.2	49.3	60
Brick, pottery, glass ... ..	47	8	78	3	19.8	35.8	50.3	64
Chemicals, paint, oil, etc. ...	55	0	90	1	25.3	35.7	47.3	64
Metal, engineering and shipbuilding ... ..	59	8	108	3	42.3	49.2	66.8	81
Textiles ... ..	37	10	64	2	29.5	37.7	56.6	70
Leather, fur, etc. ... ..	46	9	74	5	16.8	31.4	46.7	59
Clothing ... ..	35	0	54	9	12.9	27.9	46.2	56
Food, drink and tobacco ...	47	0	72	9	15.4	29.4	40.8	55
Woodworking ... ..	51	10	79	4	16.7	31.4	42.9	53
Paper, printing, stationery, etc. ... ..	57	7	80	6	1.6	17.9	27.9	40
Building, contracting ... ..	61	2	100	4	32.6	47.6	54.6	64
Other manufacturing industries ... ..	46	6	84	1	31.0	40.6	60.2	81
Transport, storage, excluding railways ... ..	65	6	95	0	20.6	25.6	37.4	45
Public utility services ... ..	59	8	80	3	10.6	20.2	27.9	34
Government industrial services ... ..	70	6	107	5	33.9	26.8	34.8	52
All the above ... ..	53	3	93	7	29.9	42.4	59.9	76

The 16 industrial groups particulars for which are shown in the above table cover 91 trades, and earnings for each of these are shown in the *Ministry of Labour Gazette* for February 1944 and earlier issues. The earnings of men, youths and boys, women and girls, are given separately, and are those of both skilled and unskilled workers. For the industries as a whole the following table shows the earnings of men, youths and boys, women and girls separately at the five dates, together with the percentage increases of the earnings at October 1938.

Date	Men (21 years and over)	Youths and Boys	Women (18 years and over)	Girls	All Workers
Average weekly earnings					
Oct. 1938 ... ..	s. 69 d. 0	s. 26 d. 1	s. 32 d. 6	s. 18 d. 6	s. 53 d. 3
July 1940 ... ..	89 0	35 1	38 11	22 4	69 2
„ 1941 ... ..	99 5	41 11	43 11	25 0	75 10
„ 1942 ... ..	111 5	46 2	54 2	30 3	85 2
„ 1943 ... ..	121 3	47 2	62 2	33 10	93 7
Percentage increase compared with October 1938					
July 1940 ... ..	29.0	34.5	19.7	20.7	29.9
„ 1941 ... ..	44.1	60.7	35.1	35.1	42.4
„ 1942 ... ..	61.5	77.0	66.7	63.5	59.9
„ 1943 ... ..	75.7	80.8	91.3	82.9	75.7

## (2) OTHER STATISTICS

During the past three years, plans for increasing *agricultural production in the United States* have been very actively pressed forward by the Government, both in order to meet the military needs of the U.S. forces at home and abroad, and also to provide for food shipments under the Lend-Lease programme. Another reason for stressing the need for greater production arises from the fact that active employment and high wages have greatly stimulated demand in home markets. The combined effect of the military requirements, the Lend-Lease shipments, and the rising domestic purchases has been to transform the accustomed American abundance into a shortage so far as civilian requirements are concerned, or at least into a position where consumers can no longer buy as much as they want to buy.

The Report of the Secretary of Agriculture for 1943 estimates that something like 13-14 per cent. of the food production of that year was required for the armed forces and possibly as much as 10 per cent. for Lend-Lease shipments, leaving approximately 75 per cent. for civilian needs. Owing to increased production, this latter proportion is about equivalent to the average amount of food produced in the years 1935-39, though the distribution of the items making up the total is probably different.

The Lend-Lease allocation, it may be noted, has much increased. In 1941 the total was about 2 per cent., and in 1942 about 6 per cent. of the total production. In 1941-42 Great Britain was the principal recipient, but in the first five months of 1943 Russia received one-third of the shipments.

The plans for increased production have met with considerable success. Taking the years 1935-39 as a base, it is estimated that the production of food crops and livestock products in 1943 had risen by about 32 per cent. and this was equivalent to a rise of 25 per cent. per head of the population. The crop increase taken by itself is less striking, owing to variations dependent on the weather and other factors. In 1942 farming benefited by an exceptionally favourable season and was one of the best crop years ever experienced. In 1943 conditions were not so good, and the output was some 6 per cent. less than in the previous year, but was nevertheless 5 per cent. more than in any previous season. Compared with the average of the five moderately favourable crop seasons 1937-41, the aggregate production of the 53 principal crops was up by 9 per cent. The major part of the effort to increase food production was, however, directed to livestock, and it is estimated that the aggregate output of cattle, sheep, pigs, poultry, eggs and milk was 8 per cent. above 1942 and 31 per cent. above 1937-41.

Farmers have naturally benefited from this expansion, which has been stimulated by methods of supporting prices, though this has been combined with and balanced by "ceiling prices" to consumers. The farm price index which averaged about 95 in the three years 1938-40 (1909-14 = 100) rose to 122 in 1941, 157 in 1942, and 188 in 1943. The index of cost of production—that is, of prices paid by farmers for living and production—also rose, but in 1942 and 1943 this index stood at a lower figure than the farm price index, so that the latter was above "parity" for the first time for some years. As a natural result of these higher prices what is called the "cash farm income" was estimated to be above any previous record.

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# STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

## UNITED KINGDOM—

*Agenda*—February 1944—The populations of Europe: displacement and replacement: *Maj.-Gen. Sir Neill Malcolm*. An essay on State control of business: *E. F. Schumacher*. Some observations on the future organization of the coal industry: *A. Beacham*. The Highlands of Scotland: proposals for development: *H. Quigley*.

*Annals of Eugenics*—May 1944—An analysis of the blood-group composition of a population in Northern Ireland: *E. W. Hart*. Experimental modification of dominance in Danforth's short-tailed mutant mice: *R. A. Fisher* and *S. B. Holt*. A demographic study of psychopathic population: *E. Slater*. Sampling moments of moments for a finite population: *J. O. Irwin* and *M. G. Kendall*.

### *The Banker*—

February 1944—The structure of the National Debt: *E. Victor Morgan*. Sterling bloc cohesion: *Paul Bareau*.

March 1944—The Bank Charter Act of 1844: *E. Victor Morgan*. The hidden hand: manoeuvres old and new: *W. T. C. King*. Irish banking in 1943: *G. A. Duncan*. Life assurance in 1943.

April 1944—Industrial banking reconsidered: *G. Eberstadt*. The Building Societies' Year: *H. E. Wincott*. Post-war housing problems: *Walter Hill*. Slide-rule economics: *Paul Bareau*.

May 1944—The new currency plan: The problem of costs: *Hermann Levy*.

*Bankers' Magazine*—February 1944—Banking profits in 1943.

*Economica*—May 1944—A liquidity preference theory of market prices: *K. E. Boulding*. Finance capitalism?: *L. M. Lachmann*. Dr. Rhodes' analysis of the distribution of single incomes in the United States: *George Garvy*.

*Economic Journal*—April 1944—The British colonial currency system: *G. L. M. Clauson*. The small nation and world trade: *K. W. Rothschild*. The prospects of the British cotton industry: *Z. Nawrocki*. The German war economy: *H. W. Singer*.

*Eugenics Review*—April 1944—Population problems in the light of differential fertility: *J. A. Fraser Roberts*.

*Geographical Journal*—March 1944—The artisan element in the Slav countries: *Mrs. J. A. Steers*.

### *Oxford Institute of Statistics, Bulletin*—

Vol. 6, No. 2—Guaranteed prices and the farmers: *S. G. Rutherford*. The distribution of incomes: *J. L. Nicholson*.

Vol. 6, No. 3—The age structure of building labour: *S. Moos*. The unimportance of a capital levy: *T. Balogh*.

Vol. 6, No. 4—Consumption of groceries: *T. Schulz*. Excess profits tax and post-war re-equipment: *M. Kalecki*. Cinema duties, consumption and prices: *P. Ady*.

Vol. 6, No. 5—The American financial position: *J. Steindl*. Reform of the Health Services: *E. J. Buckatzsch*. Fixing exchange rates in war: *T. Balogh*.

Vol. 6, No. 6—An international monetary fund: *E. F. Schumacher* and *T. Balogh*. Cost of a "human needs" diet: *T. Schulz*.

Vol. 6, No. 7—The Budget: stabilization policy: *M. Kalecki*. Budget proposals and technical progress: *T. Balogh*.



## UNITED KINGDOM—Contd.

*Review of Economic Studies*—Winter 1943—The Beveridge Plan and Local Government finance: *J. R. and U. K. Hicks*. The welfare significance of productive labour: *Hla Myint*. The four consumer's surpluses: *J. R. Hicks*. Colonial industrialization and British employment: *P. Ady*.

*Scottish Journal of Agriculture*—January 1944—The social consequences of agriculture: *W. G. S. Adams*. Some aspects of post-war agricultural marketing. *Scottish Agriculture in War time*.

*Sociological Review*—January–April 1943—The psychological background of white-coloured contacts in Britain: *K. L. Little*. National stereotypes—their nature and functions: *C. A. Mace*. An experimental investigation of national stereotypes: *Madeline Kerr*.

## INDIA—

*Indian Journal of Economics*—January 1944—Our food problem: *S. K. Rudra*. Labour in wartime: *S. R. Bose*. Teaching and research in economic statistics: *H. Sinha*.

*Sankhyā*—Vol. 6, Pt. 4, 1944—Proceedings of the Sixth Session of the Indian Statistical Conference. Stability of the income distribution: *H. Bernardelli*. Moments and product moments of moment-statistics for samples of the finite and infinite populations: *P. V. Sukhatme*. Recovery of inter-block information in incomplete block designs: *K. R. Nair*. Application of time-series analysis to data relating to Indian Posts and Telegraph Department: *Gopal Chandra Roy*. On some set of sufficient conditions leading to the normal bivariate distribution: *A. Bhattacharyya*. Confluent hyper geometric series: *P. K. Bose*. Note on adjustments for first and second moments in a grouped frequency distribution split up into sub-sections: *J. M. Sen Gupta*. On an aspect of Pearsonian system of curves: *B. C. Bhattacharya*.

## UNION OF SOUTH AFRICA—

*South African Journal of Economics*—March 1944—The concepts of money, capital and credit: *M. H. de Kock*. National income and outlay with reference to savings, capital movements and investment: *Ludwig Gruenbaum*. The use of random sampling in sociographical research: *Edward Batson*.

## UNITED STATES—

*Actuarial Society of America, Transactions*—Vol. XLIV, Pt. 2—An analysis of self-selection among annuitants, including comparisons with selection among insured lives: *Wilmer A. Jenkins*. Notes on exposure formulae: *H. S. Beers*. A fundamental proposition in the solution of simultaneous linear equations: *C. A. Spoerl*.

*American Academy of Political and Social Science, Annals*—

September 1943—The American family in world war II.

November 1943—Transportation: war and post-war.

January 1944—Higher education and the war.

*American Economic Review*—March 1944—Economy and democracy: *A. B. Wolfe*. The underwriting of aggregate consumer spending as a pillar of full-employment policy: *J. H. G. Pierson*. Some problems of methodology in modern economic theory: *Otto von Mering*. The War Labour Board: and experiment in wage stabilization: *J. C. Record*. A note on cyclical wage rigidity: *Joseph Shister*.

## UNITED STATES—Contd.

*Supplement*—March 1944—Papers and proceedings of the 56th Annual Meeting of the American Economic Association.

*American Philosophical Society*—Vol. 87, No. 4—Organization, direction, and support of research (symposium). Discovery and interpretation of biological phenomena: *Detley W. Bronk*. A critique of medical research: *Alan Gregg*. Political economy in the modern State: *Harold A. Innis*.

*Annals of Mathematical Statistics*—

December 1943—Statistical inference in the non-parametric case: *Henry Scheffe*. On the theory of sampling from finite populations: *M. H. Hansen* and *W. N. Hurwitz*. Multiple sampling with constant probability: *W. Bartky*. An exact test for randomness in the non-parametric case based on serial correlations: *A. Wald* and *J. Wolfowitz*. On a general class of "contagious" distributions: *W. Feller*. On the construction of sets of orthogonal Latin squares: *H. B. Mann*. On the dependence of sampling inspection plans upon population distributions: *Alexander M. Mood*. On card matching: *T. W. Anderson*.

March 1944—On the theory of systematic sampling I: *W. G. and L. Madow*. On the probability theory of linkage in Mendelian heredity: *Hilda Geiringer*. The covariance matrix of runs up and down: *H. Leverne* and *J. Wolfowitz*. On the measure of a random set: *H. E. Robbins*. On the distribution of the radial standard deviation: *F. E. Grubbs*. A matrix presentation of least squares and correlation theory with matrix justification of improved methods of solutions: *Paul S. Dwyer*. On the statistics of sensitivity data: *B. Epstein* and *C. W. Churchman*.

*Harvard Business Review*—Winter Number, 1944—Planning industry's future in Britain: *Walter Hill*. Canada's industrial transformation: *J. A. de Haas*.

*Journal of Political Economy*—March 1944—Diminishing returns from investment: *F. H. Knight*.

*Milbank Memorial Fund Quarterly*—April 1944—Implications of population trends for postwar policy: *Clyde V. Kiser*. Trend of the birth rate among persons on different economic levels, City of New York, 1929–1942: *Paul H. Jacobson*.

*Quarterly Journal of Economics*—February 1944—Taxation and the conservation of resources: *S. v. Ciriacy-Wantrup*. Wages and profits in the paper industry 1929–1939: *W. Rupert Maclaurin*. Income creation by means of income taxation: *Joshua C. Hubbard*. Output, employment, consumption, and investment: *W. W. Leontieff*. Period analysis and timeless equilibrium: *Wm. Fellner*.

*Review of Economic Statistics*—February 1944—The war and American agriculture: *John D. Black* and *Charles A. Gibbons*.

*Social Research*—February 1944—Economics in a unified world: *Wesley C. Mitchell*. The Public Debt in the financial structure: *A. Kähler*. Hungary, a Danubian problem: *R. Schüller*.

## MEXICO—

*Estadística*—(Inter-American)—

December 1943—Numeros indices, sus aplicaciones en la Estadística Brasileña y sugerencias referentes a su estandarización continental. Principles in commodity classification: *A. L. Neal*. Estudios de demografía interamericana: *G. Mortara*. El inventario del potencial económico de la Nación Peruana: *A. A. Parró*. La población negroide Mexicana: *C. Basauri*.

MEXICO—*Contd.*

*March 1944*—La estadística vital de futuro: *Forrest E. Linder*. Comments on commodity classification discussion: *A. Maffry*. Resumen del estudio relativo a la balanza de pagos de Chile, 1942: *H. M. Coers*. Enseñanza de la Estadística en México: *E. A. Patiño*. Estudios de demografía interamericana: *G. Mortara*. Resultados del primer Congreso Demográfico Interamericano.

## POLAND—

*Polish Science and Learning* (published in London)—*No. 4, March 1944*—The epidemics in Poland between two world wars: *Dr. B. Nowakowski*. Some aspects of the demographic position of Poland: *Dr. B. M. Sliżyński*.

## INTERNATIONAL—

*International Labour Review*—

*February 1944*—Housing: an industrial opportunity: *M. L. Colean*. The Baltic Republics and White Russia under German occupation 1941–42. Employment of prisoners of war in Great Britain. Rehabilitation of discharged Service personnel in New Zealand.

*March 1944*—The I.L.O. and post-war problems: Addresses by the *Rt. Hon. Ernest Bevin* and the *Rt. Hon. Anthony Eden* to the Governing Body. Stabilization policy in New Zealand: *H. Belshaw*. Food distribution in Latin American countries. Allowances for dependents of mobilized men in Germany: *Hedwig Wachenheim*.

*April–May 1944*—Federalism and labour legislation in India: *Sir Atul C. Chatterjee*. Unemployment compensation in the United States: *Ruth Reticker*.

## LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part III, 1943, the Society's Library has received the publications enumerated below.

## I.—OFFICIAL PUBLICATIONS

## (a) United Kingdom

- Agriculture and Fisheries, Ministry of.* Bulletins. No. 126. Report on fungus bacterial and other diseases of crops in England and Wales, for the years 1933-42. W. C. Moore. London: H.M.S.O., 1943. 9" x 6". 100 pp. 2s. No. 127. Home curing of bacon and hams: a manual of theory and practice for instructors and others. Compiled by the Small Pig Keepers Council. London: H.M.S.O., 1943. 9" x 6". 57 pp. 1s. 3d.
- Foreign Office.* Miscellaneous: No. 5. (1943.) Final Act of the International Fisheries Conference, London, 22nd October, 1943. London: H.M.S.O., 1943. Cmd. 6496. 9" x 6". 24 pp. 4d. No. 6. (1943.) United Nations Relief and Rehabilitation Administration. Resolutions and reports adopted by the Council at its first session, held at Atlantic City, New Jersey, U.S.A., November 10 to December 1, 1943. London: H.M.S.O., 1943. Cmd. 6497. 9" x 6". 90 pp. 1s. 3d.
- Health, Ministry of.* Reports on public health and medical subjects No. 91. Report on the breast-feeding of infants. London: H.M.S.O., 1943. 9" x 6". 18 pp. 4d.
- Labour and National Service, Ministry of.* Report of the Committee on minimum rates of wages and conditions of employment in connection with special arrangements for domestic help. London: H.M.S.O., 1943. Cmd. 6481. 9" x 6". 9 pp. 2d.
- Weight lifting by industrial workers. (Safety pamphlet 16.) Revised edition, November 1943. London: H.M.S.O., 1943. 9½" x 6". 37 pp. 1s.
- Scotland, Department of Health.* Infant mortality in Scotland: the report of a sub-committee of the Scientific Advisory Committee. Edinburgh: H.M.S.O., 1943. 9" x 6". 82 pp. 1s. 3d.
- Trade, Board of.* Statistical abstract for the United Kingdom in each of the last fifteen years: 8th. 1846-1860, 1861. 71 pp. 9th. 1847-1861, 1862. 72 pp. 10th. 1848-1862, 1863. 90 pp. 11th. 1849-1863, 1864. 91 pp. 12th. 1850-1864, 1865. 103 pp. 13th. 1851-1865, 1866. 117 pp. 14th. 1852-1866, 1867. 124 pp. London: 1861-67. 9½" x 6½". 7 vols. in one. [Presented by the London School of Economics.]
- Treasury.* Report on mutual aid. London: H.M.S.O., 1943. Cmd. 6483. 9" x 6". 10 pp. 2d.

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## Argentina—

- Dirección General de Estadística y Censos de la Nación.* Clasificación estadística de las causas de las defunciones (nomenclatura internacional de 1938). Desarrollo de los rubros de la nomenclatura detallada e índice alfabético de las causas de muerte. (Informe No. 93. Series D. No. 10, Demografía.) Buenos Aires: 1943. 10½" x 7½". 184 pp.
- Ministerio de Hacienda de la Nación.* El ajuste de los resultados financieros de los ejercicios de 1928 a 1936. Buenos Aires: 1938. 10½" x 7". 567 pp. [Presented by The Royal Institute of International Affairs.]

## Mozambique—

- Repertição Técnica de Estatística.* Censo da população em 1940. 11-População indígena. População total por sexos, idades e estado civil, segundo a sua distribuição por divisões administrativas. Lourenço Marques: 1943. 10½" x 7½". ix + 116 pp.

## (c) Foreign Countries—Contd.

## Portugal—

*Instituto Nacional de Estatistica.* VIII Recenseamento geral da população no continente e ilhas adjacentes em 12 de Dezembro de 1940. Vol. IV. Distrito de Braga. 328 pp. Vol. V. Distrito de Bragança. 238 pp. Lisbon: 1943. 12½" × 9½". 2 vols.

## Sweden—

*Stockholms Stads Statistiska Kontor.*

Stockholm of today: life and progress in Sweden's capital. Stockholm: Statistical Office. June 1939. 8½" × 6". 129 pp. I. map.

Specialundersökningar. Nr. 22. Demografiska undersökningar av Stockholms folkmängdstillväxt, av *Erland von Hofsten*. Stockholm: 1942. 9½" × 6". 78 pp. (English summary.)

## United States of America—

*Bureau of the Census.* General censuses and vital statistics in the Americas: an annotated bibliography of the historical censuses and current vital statistics of the 21 American Republics, the American sections of the British Commonwealth of Nations, the American Colonies of Denmark, France, and the Netherlands and the American territories and possessions of the United States. Washington: Government Printing Office, 1943. 9" × 6". ix + 151 pp.

Sixteenth census of the United States. 1940. Vital statistics rates in the United States, 1900–1940, by *Forrest E. Linder* and *Robert D. Grove*. Washington: Government Printing Office, 1943. 9" × 6". vii + 1051 pp. \$1.75.

*Bureau of Foreign and Domestic Commerce.* The United States in the world economy. The international transactions of the United States during the interwar period. By *Hal B. Lary*. Washington: Government Printing Office, 1943. London: Reprinted by H.M.S.O., 1944. 9½" × 6". viii + 216 pp. 3 tables. 2s. 6d.

*National Resources Committee.* Consumer incomes in the United States, their distribution in 1935–36. Washington: Government Printing Office, 1938. 11½" × 9". vii + 104 pp. 30c. [Presented by U.S. Office of War Information.]

*National Resources Planning Board.* Family expenditure in the United States. Statistical tables and appendixes. A National Resources Committee publication released by the National Planning Board. Washington: Government Printing Office, 1941. 11½" × 9". xxi + 209 pp. 50c. [Presented by Dr. E. C. Snow.]

*Works Progress Administration. Division of Social Research.* Workers on relief in the United States in March 1935. Vol. I. A census of usual occupations. 1935. xv + 1048 pp. By *Philip M. Hauser*. Vol. II. A study of industrial and educational backgrounds. 1939. xiii + 408 pp. By *Philip M. Hauser* and *Bruce L. Jenkinson*. Washington: Government Printing Office, 1938–39. 11½" × 9". 2 vols. [Presented by the American Library U.S. Office of War Information.]

## (d) International

## International Labour Office—

Co-operative organizations and post-war relief. (Studies and reports Series H. No. 4.) Montreal (London: P. S. King & Staples), 1943. 9" × 6". 174 pp. 4s.

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## League of Nations—

*Economic, Financial and Transit Department.* Agricultural production in Continental Europe during the 1914–1918 war and the reconstruction period. (Economic and Financial Series, 1943. II. A. 7.) Geneva: 1943. (London: Allen & Unwin.) 10½" × 8¼". 122 pp. 7s. 6d.

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- Actualités Scientifiques et Industrielles. 628 Logique et méthodologie. IV. Hasard et contingence par *J. Segond*. 66 pp. 629 Logique et méthodologie. V. Logique du pari par *J. Segond*. 47 pp. Paris: Hermann, 1938. 10" x 6½".
- Bradford Chamber of Commerce. Statistics relating to the worsted, woollen, and artificial silk trades of the United Kingdom, 1928, 1929, 1932-40 inclusive. Bradford: Chamber of Commerce, 1928-1940. 5½" x 8½". 11 vols.
- Compton (M.) and Bott (E. H.)*. British industry, its changing structure in peace and war. London: Lindsay Drummond, 1940. 8½" x 5½". viii + 304 pp. 8s. 6d.
- Crump (Norman)*. The future of money. London: Signpost Booklets, 1943. 8½" x 5½". 21 pp. 6d.
- Dalberg (Rudolf)*. Deutsche Währungs- und Kreditpolitik 1923-1926. Berlin: Reimar Hobbing, 1926. 9½" x 6½". 161 pp. [From the Author.]
- Davis (Joseph S.)*. Food as an implement of war: the responsibilities of farmers. (War-Peace pamphlets No. 3.) Stanford University: Food Research Institute, 1943. 9" x 6". 20 pp. 10c.
- Diamond (William)*. The economic thought of Woodrow Wilson. (Johns Hopkins University Studies in Historical and Political Science, LXI, No. 4.) Baltimore: Johns Hopkins Press, 1943. 9" x 6". 210 pp. + xiv.
- Ekonomisk Tidskrift*. Arg. XLII, 2, 1940. Arg. XLV, 4, 1943. Stockholm, 1940-1943. 9½" x 6½". 14 parts.
- Freeman (Harry)*. Mathematics for actuarial students. Part 1. Elementary differential and integral calculus. 1941. vii + 183 pp. 9s. Part 2. Finite differences probability and elementary statistics. 1940. viii + 339 pp. 25s. Cambridge: University Press. 8½" x 5½". 2 vols. [From the Institute of Actuaries.]
- Harvard University. Graduate School of Business Administration. Bureau of Business Research. Bulletin No. 117. Operating results of department and specialty stores in 1942. By *Malcolm P. McNair*. vi + 52 pp. \$2.50.
- Bulletin No. 118. Expenses and profits of limited price variety chains in 1942. By *Elizabeth A. Burnham*. vi. + 42 pp. \$1. Boston, Mass.: Harvard University Bureau of Business Research, 1943. 11" x 8½". [Presented by J. Menken.]
- Business Research Studies, No. 26. Advertising programs for products with selected distribution: an analytical study of the place of general advertising, dealer cooperative advertising, and dealer helps in promotional programs. By *James Dacon Scott*. v + 112 pp. \$1.
- No. 27. Make or Buy. By *James W. Culliton*. iv + 130 pp. \$1. Boston, Mass.: Harvard University Graduate School of Business Research, 1942. 11" x 8½". [Presented by J. Menken.]
- No. 29. Absenteeism: management's problem. By *John B. Fox* and *Jerome F. Scott*. 1943. vii + 28 pp. \$1.
- No. 30. War profits taxation and special war-time reserves. By *J. Keith Butters*. v + 49 pp. \$1. Boston, Mass.: Harvard University Graduate School of Business Administration, 1944. 11" x 8½". [Presented by J. Menken.]
- International Tin Research and Development Council. Statistical Year Book, 1939. The Hague (Greenford Mdx. Tin Research and Development Council). 10½" x 8½". 206 pp. 8s.
- Ingenjörsvetenskapsakademien. Handlingar (Proceedings). No. 155, 1940.—No. 175, 1943. Stockholm: 1940-1943. 9½" x 6½". 21 parts.
- Leverhulme Trust. The West African Commission 1938-1939 Technical reports. General introduction by *Col. Sandeman Allen*, *C. G. Ammon*, *E. Clement Davies* and *Dr. L. Haden Guest*. I. Crop production and soil fertility problems. By *H. C. Sampson* and *E. M. Crowther*. II. Live stock problems. By *A. G. Doherty*. London: 1943. 10" x 7". 86 pp. [Presented by the Leverhulme Trust.]
- Martin (W. J.)*. Sex ratio in war. (Reprint from *The Lancet*, Dec. 25, 1943, p. 807). 8½" x 5½". 2 pp. [From the Author.]
- National Bureau of Economic Research. The effect of war on business financing, manufacturing and trade, World War I. By *Charles H. Schmidt* and *Ralph A. Young*. (Our economy in war. Occasional paper 10, 1943.) 9" x 6". 104 pp. 50c.
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II.—Authors and Miscellaneous—*Contd.*

- National Bureau of Economic Research. British and American plans for international currency stabilization. By *J. H. Riddle*. (Our economy in war. Occasional paper 16.) New York: National Bureau of Economic Research, 1943. 9" × 6". 42 pp.
- Studies in income and wealth. Volume VI. By the Conference on Research in Income and Wealth. New York: National Bureau of Economic Research, 1943. 9½" × 5¾". xii + 288 pp. \$3.
- Ralston (Jackson H.)*. A quest for international order. Washington: John Byrne & Co., 1941. 5½" × 8½". 205 pp. [Presented by the Author.]
- Sarkar (Benoy Kumar)*. The equations of world-economy in their bearings on post-war reconstruction. Calcutta: Chuckervertty, Chatterjee & Co., 1943. 9¾" × 6¼". xix + 4 charts + 416 pp. 12 rupees.
- Wilson (George B.)*. Alcohol and the nation (a contribution to the study of the liquor problem in the United Kingdom from 1800 to 1935). London: Nicholson and Watson, 1940. 9" × 6". xii + 456 pp. Maps. 63s.
- Yates (P. Lamartine)*. Commodity control: a study of primary products. London: Jonathan Cape, 1943. 8½" × 6". 248 pp. 15s.

## PERIODICALS RECEIVED BY THE LIBRARY

### ANNUAL LIST

In addition to the publications named in the bi-monthly lists, the Society has received during the past year the official and other periodicals enumerated below.

#### (a) United Kingdom and its several Divisions

##### National

#### United Kingdom—

- Admiralty.* Navy appropriation account.  
*Agriculture and Fisheries, Ministry of.* Journal of the Ministry of Agriculture.  
*Air Ministry.* Air services appropriation account.  
*General Register Office.* Registrar-General's statistical review of England and Wales.  
 Registrar-General's weekly return of births and deaths. Quarterly return of births, deaths and marriages.  
*Health, Ministry of.* National Health Insurance Fund accounts. Summary report of the Ministry of Health.  
*Home Office.* Aliens (naturalization) return. Report of the Commissioner of Police of the Metropolis. State management districts (Licensing Act 1921) report.  
*Imperial Agricultural Bureau.* Annual report of the Executive Council.  
*Labour and National Service, Ministry of.* Annual report of the Chief Inspector of Factories. Ministry of Labour gazette.  
 — & *Ministry of Production.* Production and engineering bulletin.  
*Medical Research Council.* Bulletin of war medicine.  
*Parliament.* Parliamentary debates; House of Commons; House of Lords. The public general acts and the Church Assembly measures.  
*Stationery Office.* Government publications, consolidated list.  
*Trade, Board of.* Board of Trade journal.  
*Treasury.* Account of the public income and expenditure. Civil appropriation accounts. Civil estimates. Finance accounts. Financial statement. Revenue departments appropriation accounts. Trading accounts and balance sheets.  
 Votes of credit.  
*War Office.* Army appropriation account.

##### Municipal and other local returns

IPSWICH: Abstract of the audited accounts. LIVERPOOL: Report on the health of the City. MANCHESTER: Abridged report on the health of the City.

#### Scotland—

- Agriculture, Department of.* Scottish journal of agriculture.  
*Registrar-General.* Annual report of the Registrar-General. Births, deaths and marriages [weekly and quarterly returns].  
 GLASGOW: Report of the Medical Officer of Health.

#### Northern Ireland—

- General Register Office.* Quarterly return of births, deaths and marriages.

##### Miscellaneous Publications

Accountant. Accountants' magazine. Agenda. Alliance news. Anglo-Swedish review. Annals of eugenics. Auctioneers' and Estate Agents' Institute, Journal. Banker. Bankers' almanac and year-book. Bankers' Clearing House, annual statement. Bankers' magazine. Bank of England, Statistical summary. Belfast, Queen's University calendar. Biometrika. Bradford Chamber of Commerce: Statistics relating to the worsted, woollen and artificial silk trades. British Association for the Advancement of Science, The advancement of science. Building industries survey. Building societies year-book.



(a) United Kingdom and its several Divisions—*Contd.*

Cambridge University abstract of dissertations. Chamber of Commerce journal. Chamber of Shipping of the U.K., annual report. Chartered Surveyors' Institution, Journal. Colliery guardian. Co-operative Union Ltd.: Co-operative review. Report of the annual co-operative congress. Corporation of Foreign Bondholders, annual report. Czechoslovak Medical Association in Great Britain, Bulletin.

Dalgely's annual wool review.

Economic journal. *Economica*. Economist. *Economista Polski*. *Eugenics* review.

Fabian Society: Fabian news, Fabian quarterly, Research series, Tract series. Faculty of Actuaries: Transactions, Year-book. Fireman.

Geographical journal.

Health and empire.

Incorporated Association of Rating and Valuation Officers, Journal. Institute of Actuaries: Journal, Year-book. Institute of Bankers, Journal. Institute of Industrial Administration, Journal. Insurance directory and year-book. International Federation of Trade Unions, Bulletin. International Tin Research and Development Council, Statistical year-book. Iron and Steel Institute, Journal.

King Edward's Hospital Fund: Annual report, Statistical summary.

Land and liberty. London and Cambridge Economic Service: Bulletin.

Mallett and Co., Weekly wool chart. Manchester Statistical Society, Transactions. Manchester University calendar. Municipal year-book.

National Association for Prevention of Tuberculosis: Report of Council. National Institute of Economic and Social Research: Annual report, Diary. Nature.

Oxford Institute of Statistics: Annual report, Bulletin.

Peabody Donation Fund, Annual report of Governors. People's year-book. Planning. Post magazine. Powers-Samas magazine. Public administration. Quarterly journal of mathematics.

Rates levied on various towns. Registered accountant. Review of economic studies. Royal Agricultural Society of England, Journal. Royal College of Surgeons of England, Calendar. Royal Institute of International Affairs, Annual report of the Council. Royal Institution, Proceedings. Royal Meteorological Society, Journal. Royal Sanitary Institute, Journal. Royal Society of Arts, Journal. Royal Society of Edinburgh: Proceedings, Transactions.

Samuel Montagu and Co.: Monthly letter, Annual bullion review. Secretary. Seyd (R.E.), statistics of failures. Signal. Society of Incorporated Accountants and Auditors, Year book. Sociological review. Statesman's year book. Statist. Tabulator. Tattersall's cotton trade review (Dec. issue). Taxation. Times. Times literary supplement. Times trade and engineering. Tin.

United empire.

Whitaker's almanack. Who's who. Willing's press guide.

## (b) British Empire

## Australia—

*Bureau of Census and Statistics*. Finance. Monthly review of business statistics. Press notices. Quarterly summary of Australian statistics.

*Commonwealth Grants Commission*. Report.

Commonwealth Bank of Australia. Statistical bulletin.

Economic record.

## NEW SOUTH WALES—

*Bureau of Statistics and Economics*. Official year book of New South Wales. Statistical bulletin. Statistical register.

*Department of Railways*. Report of the Commissioner for Railways.

*Parliament*. Report of the Auditor-General. Schedule for the estimates.

## SOUTH AUSTRALIA—

*Statistical Office*. Statesman's pocket year-book. Statistical register.

## (b) British Empire—Contd.

## TASMANIA—

*Bureau of Census and Statistics, Tasmania Branch.* Pocket year book of Tasmania.  
*Statistics of the State of Tasmania.*  
*State Finance Committee.* The Tasmanian economy.

## VICTORIA—

*Office of the Government Statist.* Victorian year-book. Annual report on friendly societies.

## WESTERN AUSTRALIA—

*Government Statistician's Department.* Pocket year-book. Quarterly statistical abstract. Statistical register.  
*Registrar of Friendly Societies.* Report of proceedings.

## Canada—

*Bank of Canada.* Statistical summary.  
*Department of Agriculture.* Report of the Veterinary Director-General.  
*Department of Finance.* Public accounts.  
*Department of Justice.* Annual report of the Superintendent of Penitentiaries.  
*Department of Labour.* Labour gazette. Wages and hours of labour.  
*Dominion Bureau of Statistics.*  
*Fisheries and Animal Products Branch.* Fisheries statistics. Statistics of dairy factories.  
*General Manufactures Branch.* Food products, beverages, rubber and miscellaneous manufactures based on vegetable products. Manufacturing industries of Canada, summary report. Textile industries of Canada.  
*General Statistics Branch.* Canada year book. Monthly review of business statistics.  
*Mining, Metallurgical and Chemical Branch.* Chemicals and allied products in Canada. Coal statistics for Canada. Iron and steel and their products in Canada. Manufactures of non-metallic minerals in Canada.  
*Vital Statistics Branch.* Vital statistics.

ALBERTA. *Department of Public Health.* Annual report of the Vital Statistics Branch.

ONTARIO (PROVINCE). *Department of Agriculture.* Annual report of the Statistics Branch. Monthly crop report. Monthly dairy report. Report of the Minister of Agriculture.

QUEBEC (PROVINCE). *Bulletin météorologique.* Statistical year-book.

Bank of Nova Scotia, Monthly review.

Canadian Bank of Commerce, Monthly commercial letter.

Royal Bank of Canada. Monthly letters.

## Ceylon—

Administrative reports. Ceylon sessional papers. Minutes of the State Council.

## Éire—

*Central Bank of Ireland.* Quarterly statistical bulletin.

*Department of Industry and Commerce.* Irish trade journal and statistical bulletin. Statistical abstract.

*Department of Local Government and Public Health.* Annual report of the Registrar-General. Quarterly return of the marriages, births and deaths.

Irish Agricultural Organization Society Ltd. Report.

Statistical and Social Inquiry Society of Ireland, Journal.

## India—

*Department of Commercial Intelligence and Statistics.* Accounts relating to sea-borne trade and navigation. Monthly statistics of cotton spinning and weaving. Statistical abstract for British India.

*Reserve Bank of India.* Statistical tables relating to banks in India and Burma.

*Statistical Research Branch.* Review of the trade of India.

## (b) British Empire—Contd.

## India—Contd.

BOMBAY. Labour gazette.  
 PUNJAB. Memoirs of the Irrigation Research Institute.  
 Indian journal of economics.  
 Karachi cotton annual.  
 Sankhyā, Indian journal of statistics.

## New Zealand—

*Census and Statistics Department.* Agricultural and pastoral production. Factory and building production. Friendly societies and trade unions. Monthly abstract of statistics. New Zealand official year-book. Population and buildings. Statistical report on prices, wages . . . banking, building societies, commercial afforestation, incomes and income tax. Trade and shipping. Vital statistics.  
*National Provident Fund.* Annual report of the Board.  
 Auckland Chamber of Commerce. The Commerce journal.  
 Canterbury Chamber of Commerce, Bulletin.  
 Royal Society of New Zealand, Transactions and proceedings.

## Palestine—

*Department of Migration.* Statistics of migration and naturalization.  
*Office of Statistics.* General monthly bulletin of current statistics. Statistical abstract of Palestine. Statistics of imports, exports and shipping.

## Southern Rhodesia—

*Department of Statistics.* Economic and statistical bulletin.  
 Chamber of Mines of Rhodesia: Annual report. Report of Executive Committee (monthly).

## Union of South Africa—

*Department of Customs and Excise.* Annual statement of the trade and shipping.  
*Office of Census and Statistics.* Official year-book.  
 CAPE OF GOOD HOPE. Ordinances.  
 South African journal of economics.

## (c) Foreign Countries

## Argentine Republic—

*Dirección General de Estadística.* Anuario del comercio exterior. El comercio exterior Argentino. Informe: El comercio exterior Argentino, Estadística industrial, La población y el movimiento demográfico.  
 BUENOS AIRES (PROVINCIA DE). Anuario estadístico.  
 Camoati.  
 Rivista del Banco de la Nación Argentina.

## Brazil—

*Conselho Federal de Comercio Exterior.* Boletim.

## Chile—

*Dirección General de Estadística.* Estadística Chilena.

## Egypt—

*Département de la Statistique Générale.* Monthly bulletin of agricultural and economic statistics. Weekly return of births, deaths, and infectious diseases.  
 L'Egypte contemporaine.

## Iceland—

*Bureau de Statistique.* Statistique de l'Islande [including annual reports on agriculture, fisheries, trade, etc.].  
*National Bank of Iceland and Statistical Bureau of Iceland.* Statistical bulletin.

## (c) Foreign Countries—Contd.

## Mexico—

*Dirección General de Estadística.* Revista de estadística.  
*Estadística*, journal of the Inter-American Statistical Institute.

## Mozambique—

*Repartição Técnica de Estatística.* Anuário estatístico. Boletim trimestriel de estatística. *Estatística do comércio externo da navegação.*

## Peru—

*Departamento de Estadística General de Aduanas.* Anuario del comercio exterior. Boletín de la Superintendencia General de Aduanas.  
*Banco Central de Reserva*, Boletín. Memoria.

## Portugal—

*Instituto Nacional de Estatística.* Anuário demográfico. Anuário estatístico. Anuário estatístico das contribuições e impostos. Boletim mensal, comércio externo. *Estatística da organização corporativa.* *Estatística judiciária.* *Situação bancária.*

## Spain—

*Dirección General de Estadística.* Anuario estadístico de España. Boletín de estadística.

## Sweden—

*Statistiska Centralbyrån.* Statistisk årsbok. Statistiska meddelanden; Ser. A. Ser. D (Järnvägsstatistiska meddelanden). Ser. E (Uppgifter om bankerna). Sveriges officiella statistik.  
*Stockholms Stats Statistiska Kontor.* Statistisk årsbok.  
*Ekonomisk tidskrift.*  
*Ingeniörsvetenskapsakademien Handlingar.*

## Switzerland—

*Bureau Fédéral des Assurances.* Les entreprises d'assurances privées en suisse.  
*BASEL.* *Statistisches Amt.* Statistisches Jahrbuch des Kantons Basel-Stadt.  
*ZÜRICH.* Statistisches Jahrbuch der Stadt Zürich. Zürcher statistische Nachrichten.  
*Union suisse du Commerce et de l'Industrie*, Rapport sur le commerce et l'industrie de la Suisse.

## United States—

*Agriculture, Department of.* Agricultural statistics. Crops and markets. Year-book.  
*Children's Bureau.* Bureau publications. The child: monthly bulletin. Social statistics.  
*Education, Office of.* Annual Report of the United States Commissioner of Education. Biennial survey of education. Bulletin. School life.  
*Federal Reserve System.* Annual report of the Board of Governors. Federal Reserve bulletin.  
*Foreign and Domestic Commerce, Bureau of.* Foreign commerce and navigation for the calendar year. Foreign commerce weekly.  
*Treasury.* Annual report of the Secretary of the Treasury on the state of the finances. Annual report of the Director of the Mint.  
*Women's Bureau.* Bulletin.  
*CONNECTICUT.* Report of the State Department of Health. Connecticut health bulletin.  
*HARTFORD (Conn.).* Report of the Public Welfare Commission.  
*NEW YORK STATE.* *State Department of Health.* Monthly vital statistics review.  
*NEW YORK CITY.* New York Public Library, bulletin.  
*Actuarial Society of America, Transactions.* American Academy of Political and Social Science, Annals. American economic review. American Institute of Actuaries: The Record. American Philosophical Society: Memoirs, Proceedings, Transactions, Year-book. American Statistical Association Bulletin, Journal. Annals of mathematical statistics.

(c) Foreign Countries—*Contd.***United States—*Contd.***

Econometrica.

Harvard business review.

Illinois (University of). Bureau of Business Research. Bulletin series.

International conciliation.

Journal of calendar reform. Journal of experimental education. Journal of political economy.

Mathematical reviews. Metropolitan Life Insurance Co., Statistical bulletin. Milbank Memorial Fund: Annual report, Collected papers on research, Quarterly bulletin.

Quarterly journal of economics.

Review of economic statistics.

Smithsonian Institution: Smithsonian miscellaneous publications. Social research. Stanford University Food Research Institute, Wheat studies.

**Uruguay—**

*Contaduría General de la Nación.* Boletín de hacienda.

*Dirección General de Estadística.* Anuario estadístico de la Republica. Síntesis estadística.

## (d) International

**Bank for International Settlements—**

Annual report. Statement of account [monthly].

**International Institute of Agriculture—**

International review of agriculture.

**International Labour Office—**

International labour review. Studies and reports. Year-book of labour statistics.

**League of Nations—**

*Economic and Financial Section.* Money and banking. Monthly bulletin of statistics. Statistical year-book of the League of Nations. World economic survey.

*Health Organisation.* Annual epidemiological report. Bulletin.

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